Rapid Ecological Assessment (REA) Survey Methodology:

#3. Benthic Habitat Surveys

Coral Reef Ecosystem Program (CREP)

January 2016

We’re fish counters… why are we collecting benthic data??

Coral reefs are important habitats for fish communities, providing habitat, food and shelter.

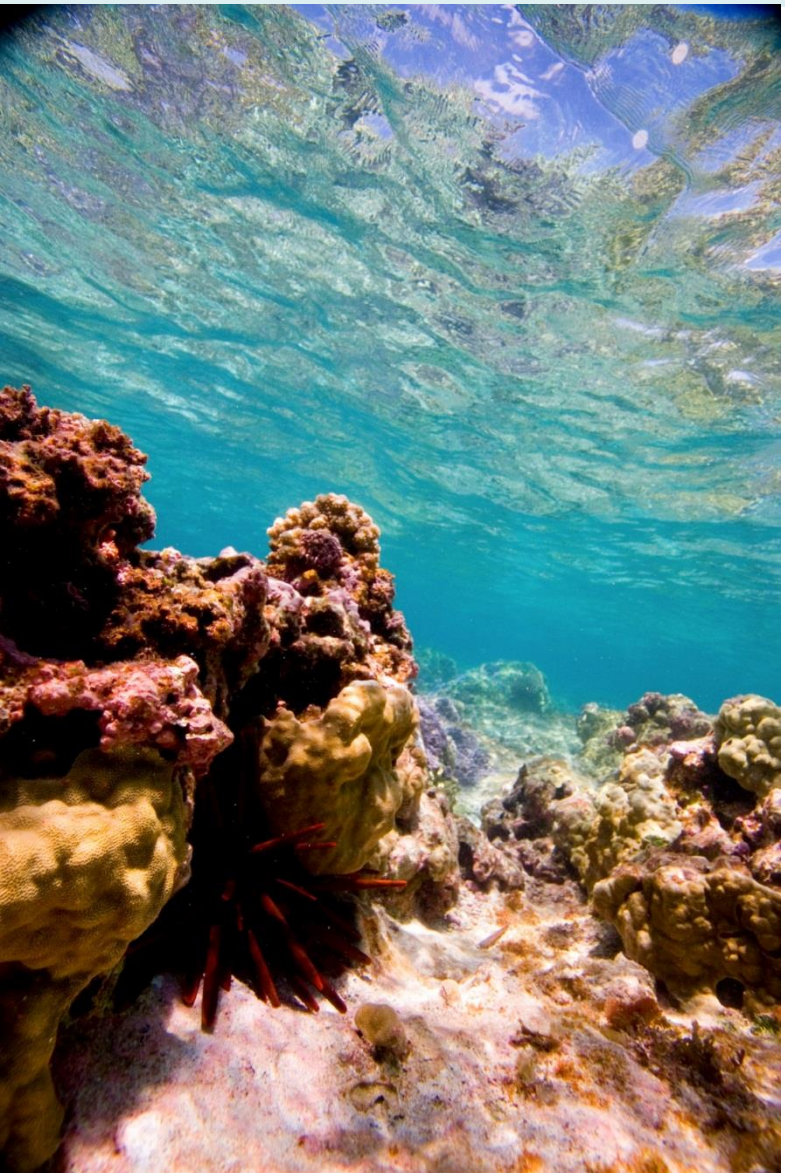
Reef characteristics such as coral cover, presence of herbivores, and substrate complexity have been correlated with fish abundance, species richness, and other factors.

Benthic cover

Importance in collecting cover data

- It is widely accepted that in general, a healthy reef typically has:
  - Relatively high % coral cover
  - Moderate % crustose coralline, calcareous, and short turf algae
  - Low % fleshy macroalgae
- Nonetheless, reefs can naturally exhibit moderate-low % coral cover. They are a variable habitat type!

Benthic habitat assessment data collected:



- Benthic cover
- Habitat type
- Substrate height
- Slope
- Urchins

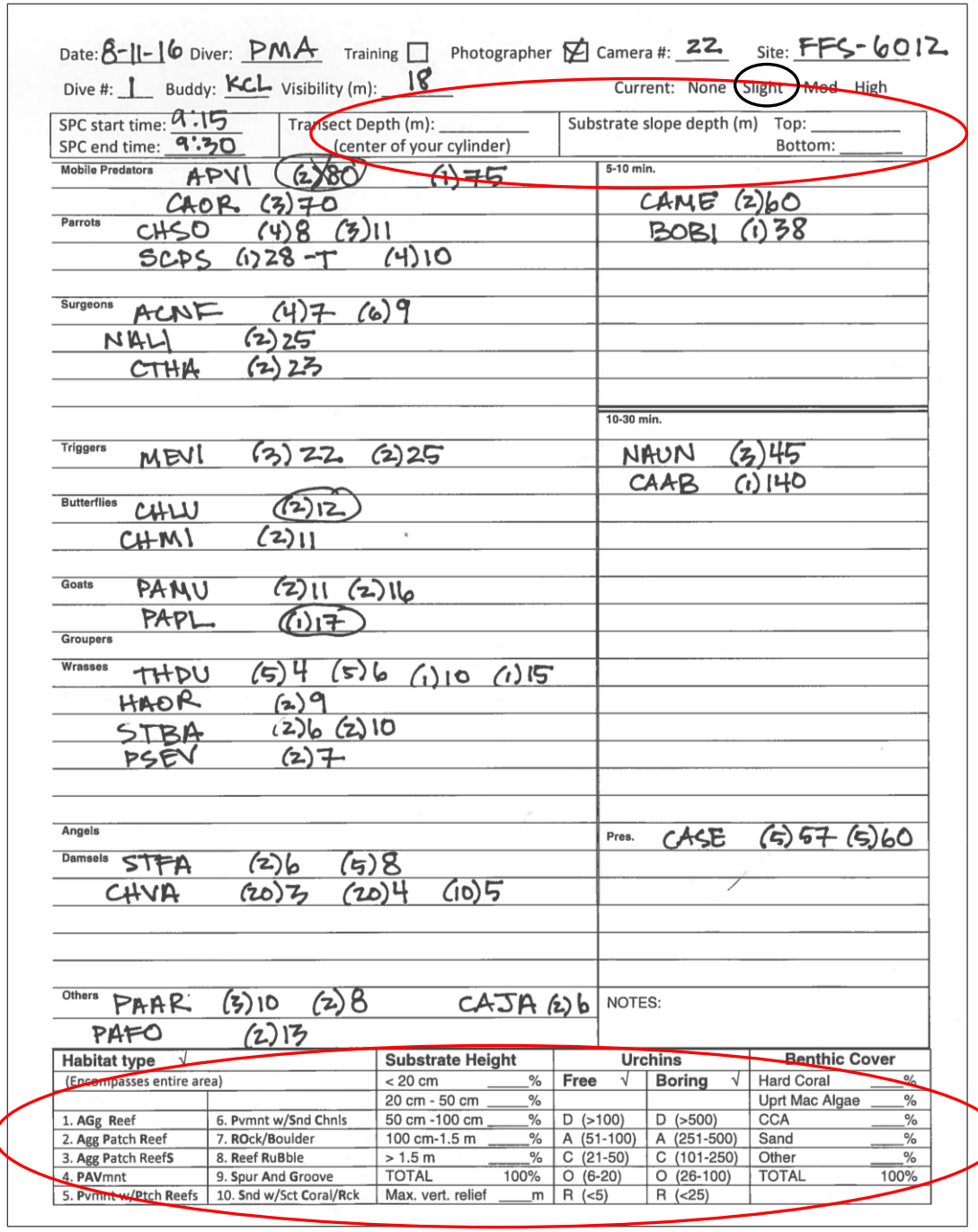
and…

- Benthic photos

Data collection sheet

Fish data complete

Benthic data



Date: 8-11-16 Diver: PMA Training ☐ Photographer ☒ Camera #: 22 Site: FFS-6012

Dive #: 1 Buddy: KCL Visibility (m): 18 Current: None (Slight) Med High

SPC start time: 9:15 SPC end time: 9:30 | Transect Depth (m): _____ (center of your cylinder) | Substrate slope depth (m) Top: _____ Bottom: _____

		5-10 min.
Mobile Predators	APVI (2)80 (1)75	CAME (2)60
	CAOR (3)70	BOBI (1)38
Parrots	CHSO (4)8 (3)11	
	SCPS (1)28-T (4)10	
Surgeons	ACNF (4)7 (6)9	
	NALI (2)25	
	CTHA (2)23	
		10-30 min.
Triggers	MEVI (3)22 (2)25	NAUN (3)45
		CAAB (1)140
Butterflies	CHLU (2)12	
	CHMI (2)11	
Goats	PAMU (2)11 (2)16	
	PAPL (1)17	
Groupers		
Wrasses	THDU (5)4 (5)6 (1)10 (1)15	
	HAOR (2)9	
	STBA (2)6 (2)10	
	PSEV (2)7	
Angels		Pres. CASE (5)57 (5)60
Damsels	STFA (2)6 (5)8	
	CHVA (20)3 (20)4 (10)5	
Others	PAAR (3)10 (2)8 CAJA (2)6	NOTES:
	PAFO (2)13	

Habitat type √		Substrate Height	Urchins		Benthic Cover
(Encompasses entire area)		< 20 cm ____%	Free √	Boring √	Hard Coral ____%
		20 cm - 50 cm ____%			Uprt Mac Algae ____%
1. AGg Reef	6. Pvmnt w/Snd Chnls	50 cm -100 cm ____%	D (>100)	D (>500)	CCA ____%
2. Agg Patch Reef	7. ROck/Boulder	100 cm-1.5 m ____%	A (51-100)	A (251-500)	Sand ____%
3. Agg Patch ReefS	8. Reef RuBble	> 1.5 m ____%	C (21-50)	C (101-250)	Other ____%
4. PAVmnt	9. Spur And Groove	TOTAL 100%	O (6-20)	O (26-100)	TOTAL 100%
5. Pvmnt w/Ptch Reefs	10. Snd w/Sct Coral/Rck	Max. vert. relief ____m	R (<5)	R (<25)	

Data collection: benthic data – a quick look

Date: 8-11-16 Diver: PMA Training ☐ Photographer ☑ Camera #: 22 Site: FFS-6012

Dive #: 1 Buddy: KCL Visibility (m): 18 Current: None (Slight) Mod High

SPC start time: 9:15 SPC end time: 9:30	Transect Depth (m): 12 (center of your cylinder)	Substrate slope depth (m) Top: 10 Bottom: 13

Habitat type √		Substrate Height	Urchins		Benthic Cover
(Encompasses entire area)		< 20 cm 30 %	Free √	Boring √	Hard Coral 20 %
		20 cm - 50 cm 40 %			Uprt Mac Algae 10 %
1. AGg Reef ✓	6. Pvmnt w/Snd Chnls	50 cm -100 cm 20 %	D (>100)	D (>500)	CCA 5 %
2. Agg Patch Reef	7. ROck/Boulder	100 cm-1.5 m 10 %	A (51-100)	A (251-500)	Sand 2 %
3. Agg Patch ReefS	8. Reef RuBble	> 1.5 m ____ %	C (21-50)	C (101-250)	Other 63 %
4. PAVmnt	9. Spur And Groove	TOTAL 100%	O (6-20)	O (26-100) ✓	TOTAL 100%
5. Pvmnt w/Ptch Reefs	10. Snd w/Sct Coral/Rck	Max. vert. relief 1.2 m	R (<5) ✓	R (<25)	

At the end of the fish survey, both divers will collect benthic data, including cover, habitat type, # urchins, and substrate height (complexity).

One diver from each team will take photos of the substrate at 1m intervals.

Estimates for:

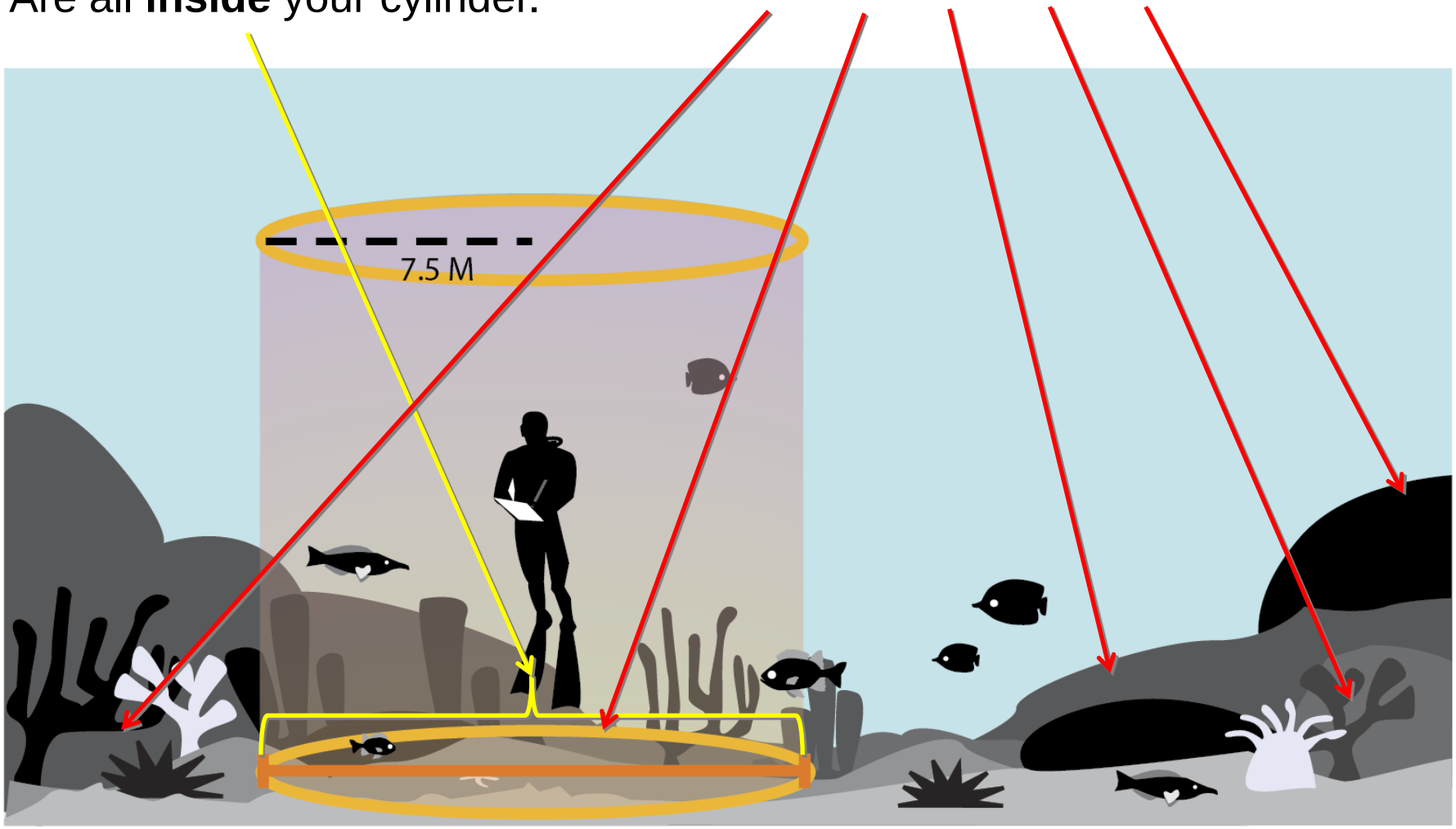
- Benthic cover
- Substrate height
- Urchins

Are all **inside** your cylinder.

Estimates for:

- Habitat type

Are for the general area in and around your cylinder.



Benthic cover

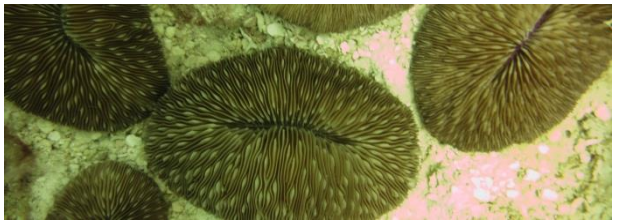
Benthic Cover	
Hard Coral	____%
Uprt Mac Algae	____%
CCA	____%
Sand	____%
Other	____%
TOTAL	100%

Categories:

- Hard Coral
- Upright Macroalgae
- Crustose Coralline Algae (CCA)
- Sand
- Other

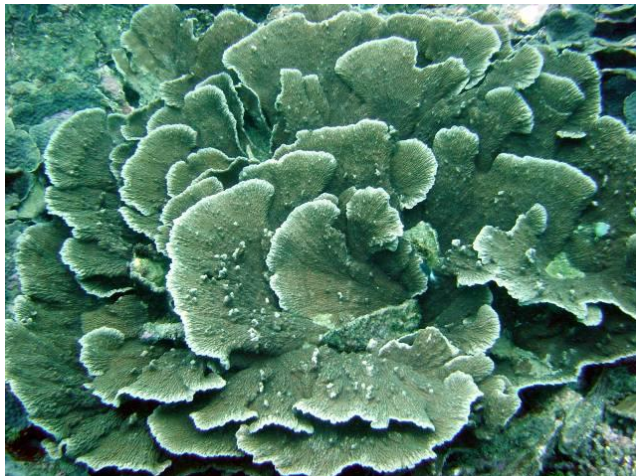
Benthic cover

Hard Corals



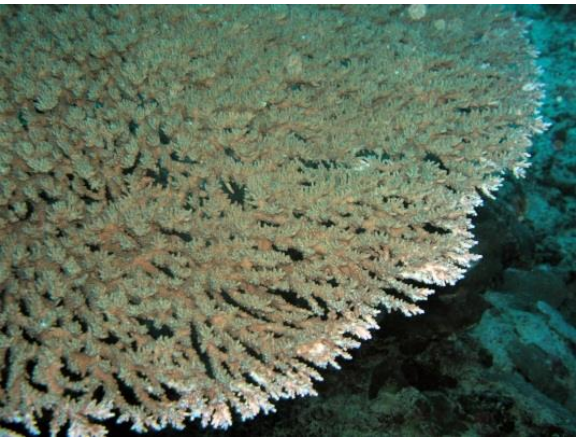
Hard corals are characterized by coral colonies or portions of colonies that are covered with living tissue. Living tissue usually appears colored due to the presence of pigments in coral tissue and/or their symbiotic zooxanthellae.

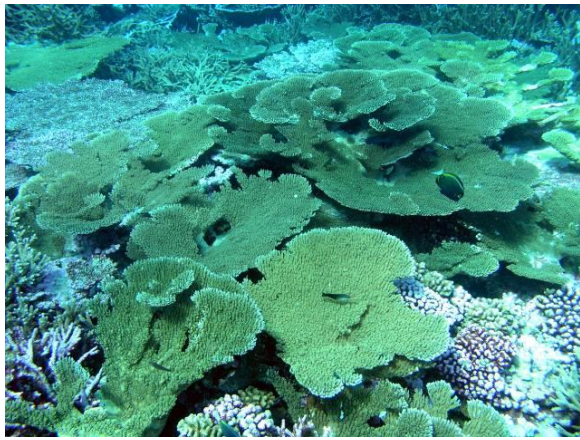
Morphologies for hard corals can range from branching, foliose, columnar, massive, free-living, and encrusting. Examples are the genera *Porites*, *Montipora*, *Acropora*, *Pavona.*



Benthic cover

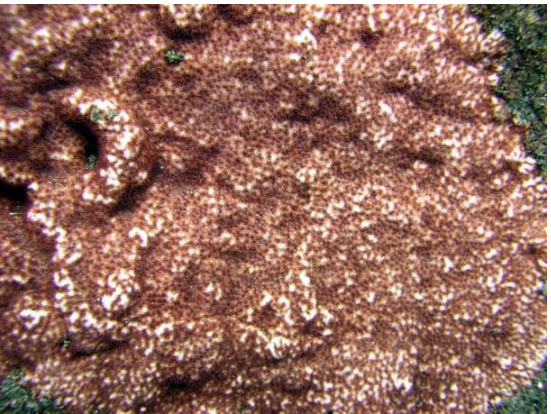
Hard Corals

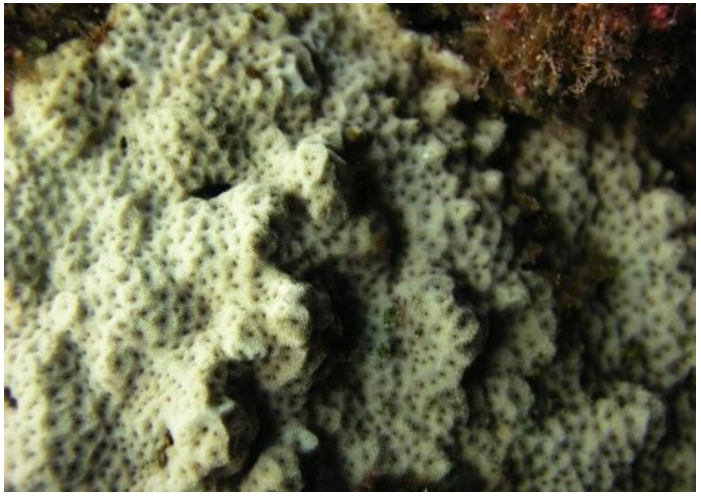


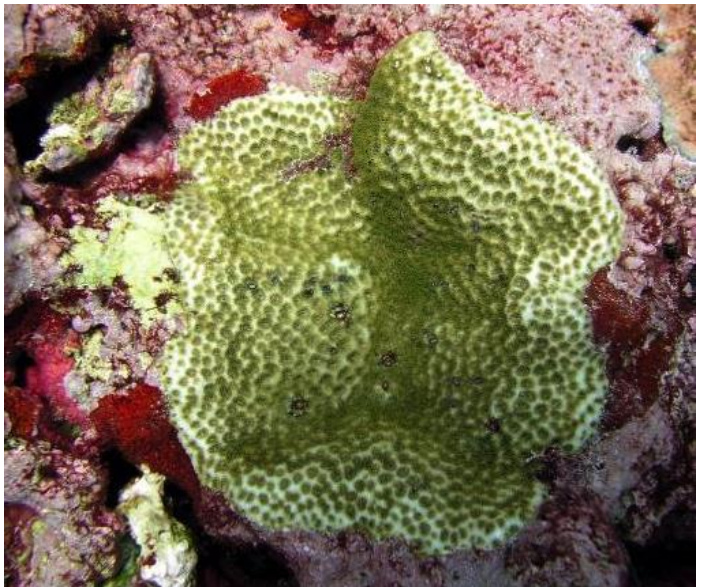


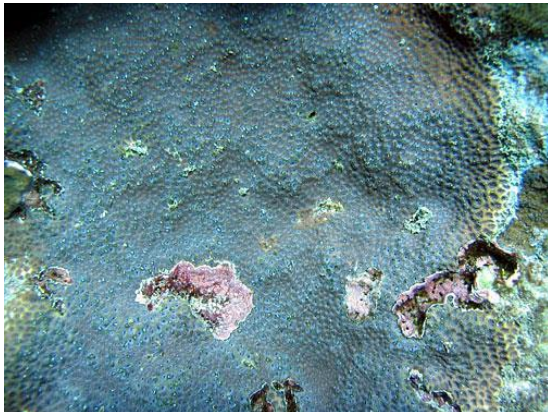
Benthic cover

Hard Corals



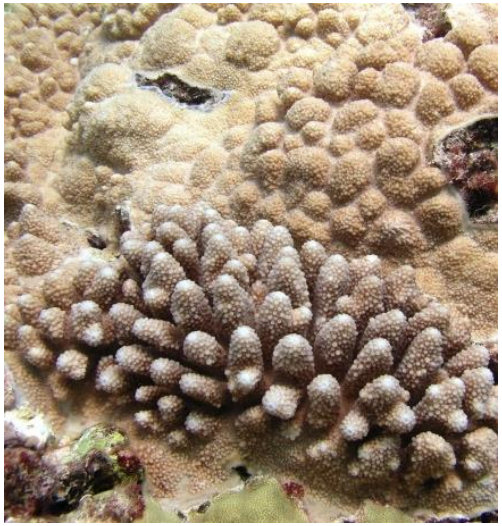






Benthic cover

Hard Corals

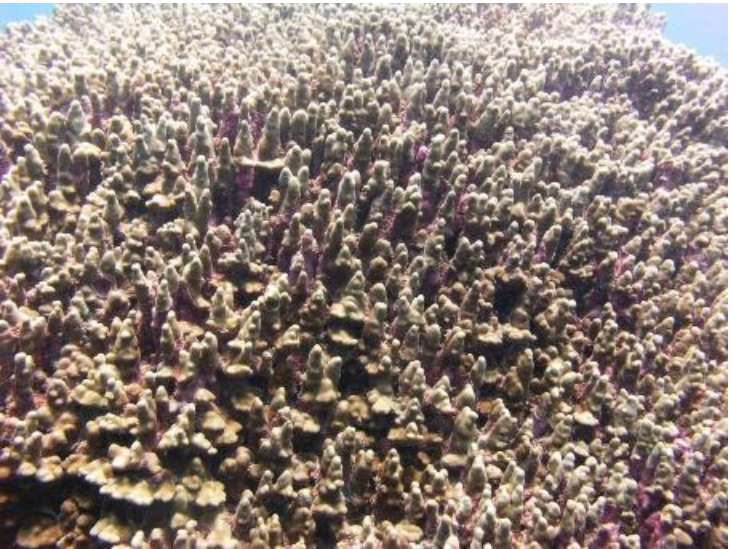





Benthic cover

Hard Corals



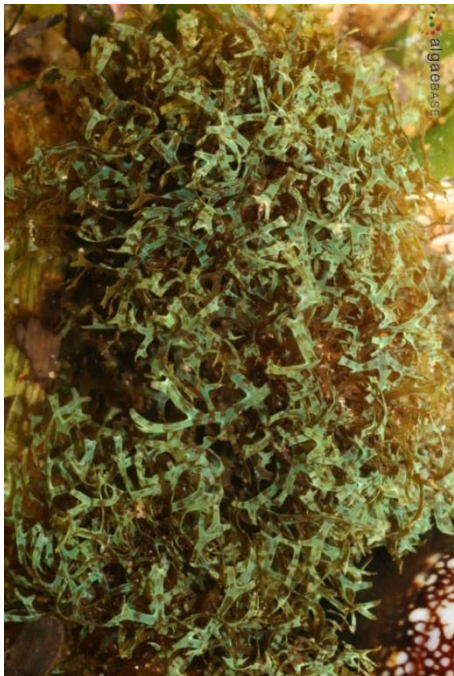




Benthic cover

Upright Macroalgae

Upright macroalgae, or “fleshy” macroalgae are visible to the naked eye (typically > 1cm), with evident structure i.e., distinct leaves, blades, ferns, feathers, balls, branched shrubs, etc., and do not form crusts bound to rubble or the substrate.

Examples are the genera *Halimeda, Microdictyon, Dictyota*, *Liagora.*

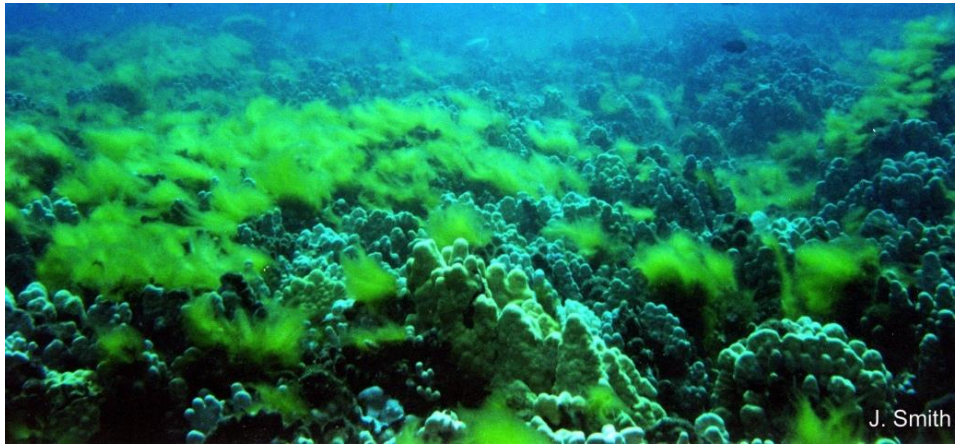


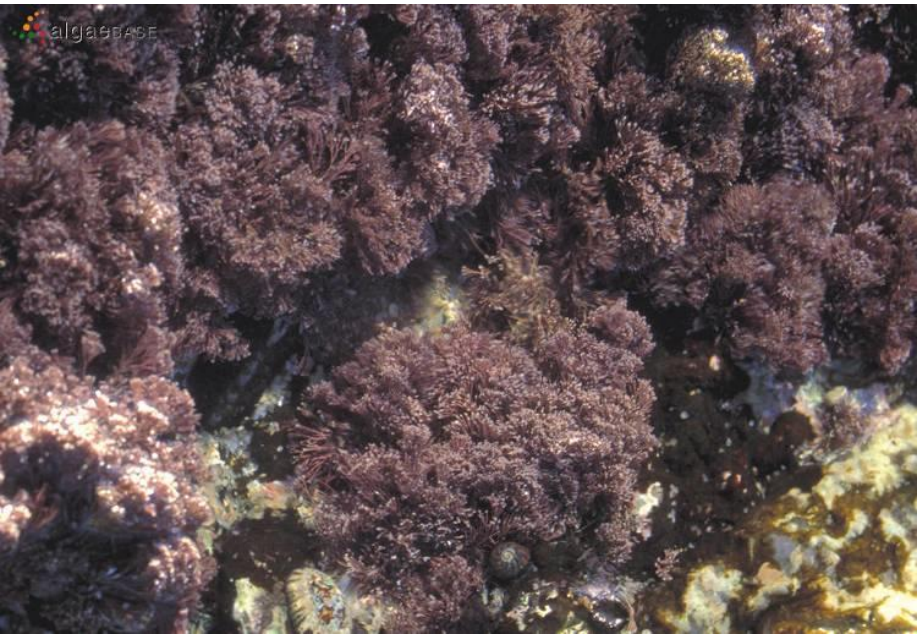
Benthic cover

Upright Macroalgae

Benthic cover

Upright Macroalgae





Benthic cover

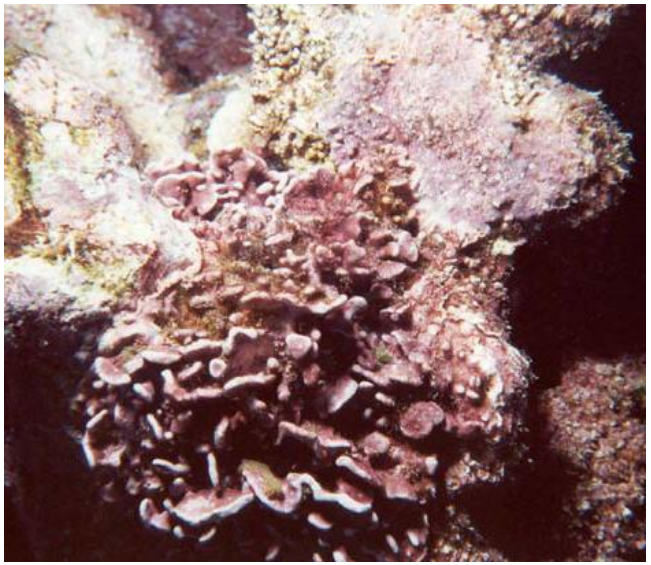
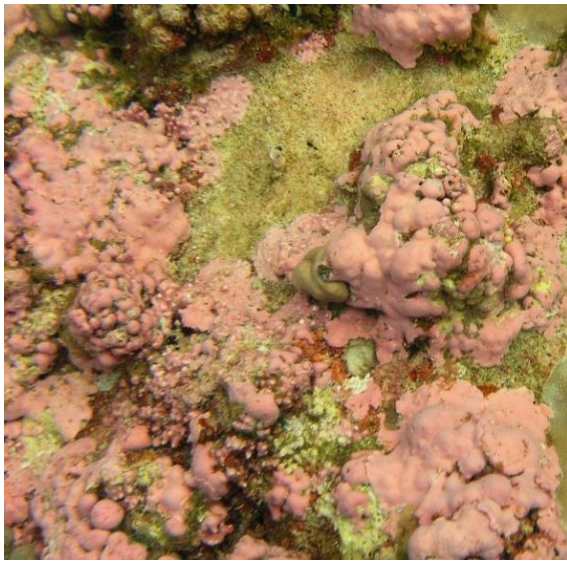
Crustose Coralline Algae (CCA)

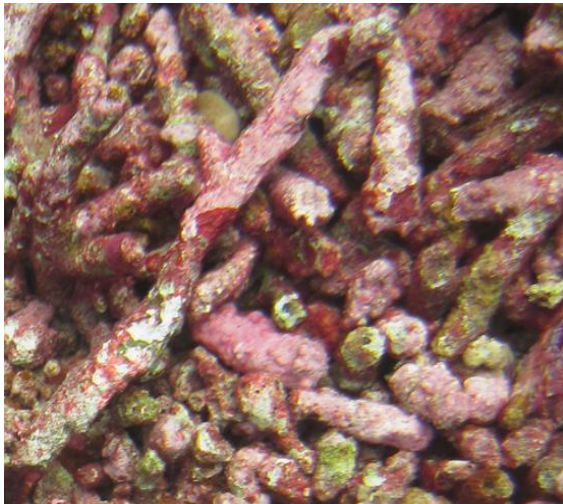
Crustose Coralline Algae (CCA) are encrusting red algae that deposit calcium carbonate as part of their structure, often giving a pinkish or lavender appearance to the encrusted substrate. In some areas, these algae can also form three dimensional spires.

Crustose red algae from the family Peyssonneliacae, functionally similar to CCA and often difficult to distinguish, may be included in this category.

Benthic cover

Crustose Coralline Algae (CCA)

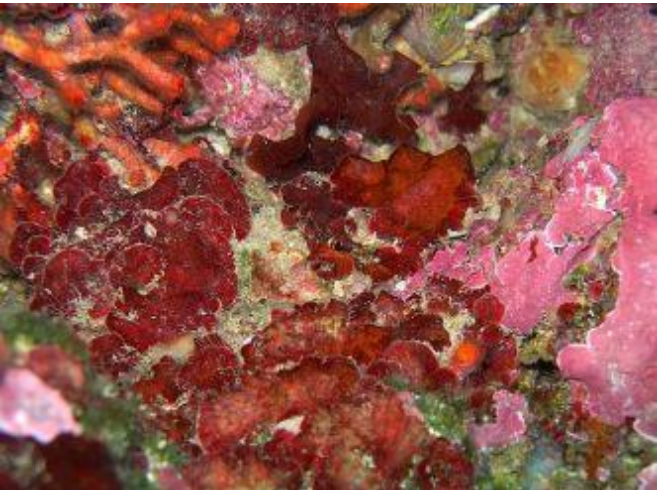




Benthic cover

Crustose Coralline Algae (CCA)

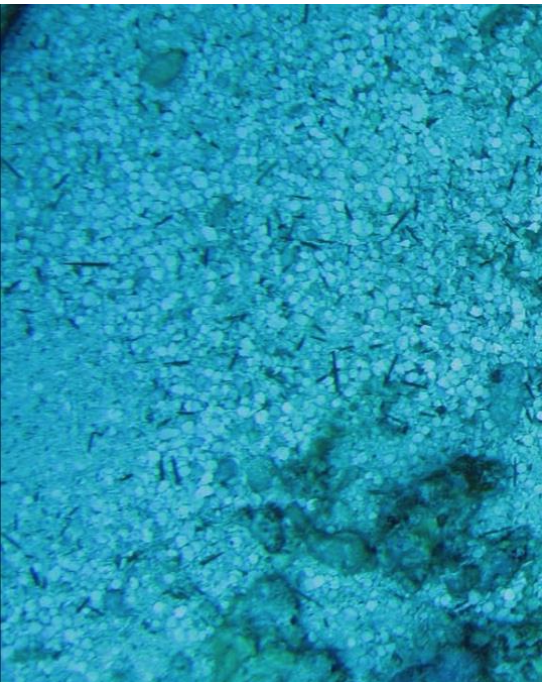
Peyssonnelia spp. are crust-like, relatively thin, and are frequently calcified underneath. Surface is smooth and varies from scarlet, dark rose, wine red to maroon in color.

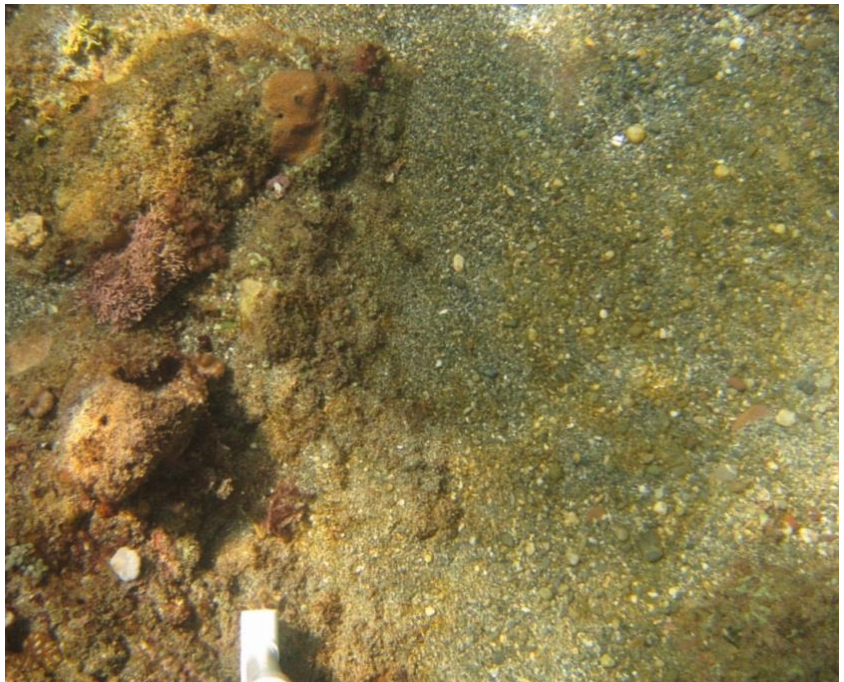


Benthic cover

Sand

Sand is unconsolidated sediment, ranging in texture and size from fine to coarse and including both inorganic (eroded rock) and organic (eroded fragments of calcareous organisms) sediments. It is assigned to areas that can clearly be distinguished as granular, loose sand, generally > 1 cm deep.





Benthic cover

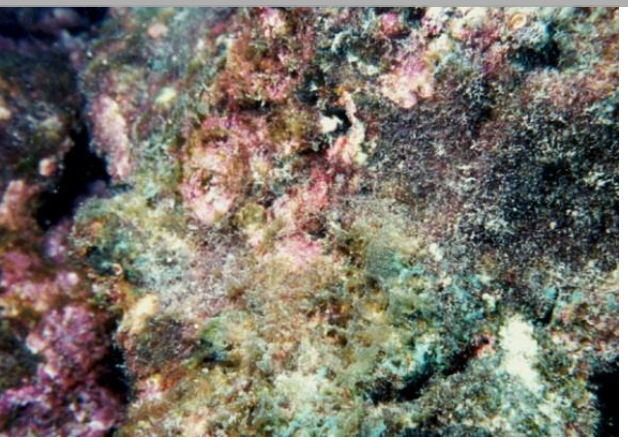
Other

Other is a category that encompasses the balance of what's in your cylinder that doesn't fit into the other 4 categories.

Included in this category are organisms such as zoanthids, giant clams, cyanobacteria, soft coral, sponges, etc. Turf algae also belongs in this category.

While you won't be quantifying any of these organisms, it is important that you are able to distinguish them from coral, algae, CCA or sand.

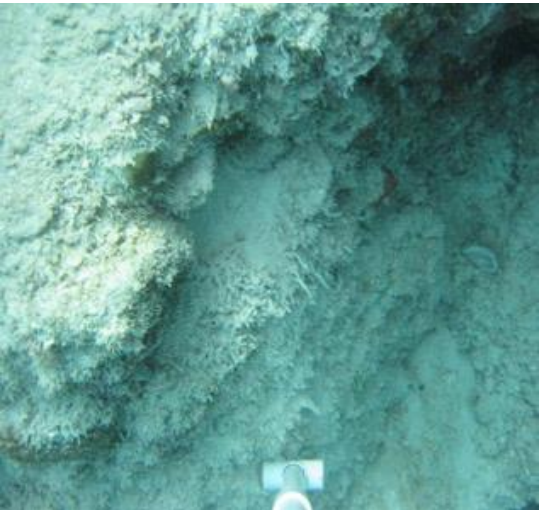
Benthic cover

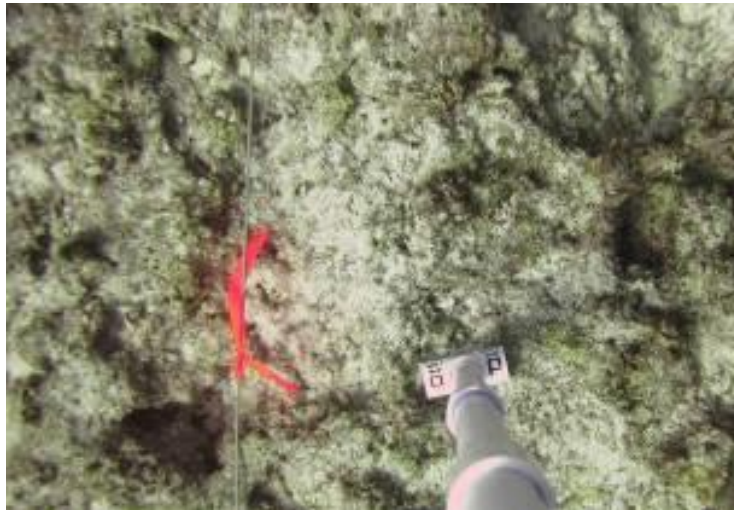


Other

Turf algae

Turf algae are a multispecies assemblage of diminutive algae that attain a canopy height of <1 cm. Turf often appears as fuzzy carpets growing on hard substrates as well as rubble. It can trap a fine layer of sediment but should not be classified as Sand.





Benthic cover

Other

Cyanobacteria

Also know as blue-green algae, it often forms deep purple to black filamentous tufts or mats, and may also form mucilaginous masses that are white or pale yellow.

Benthic cover

Other

Soft coral

Soft corals and gorgonians, known as octocorals, produce skeletal elements of protein and calcium carbonate that give the colony soft support and flexibility.

Benthic cover

Other

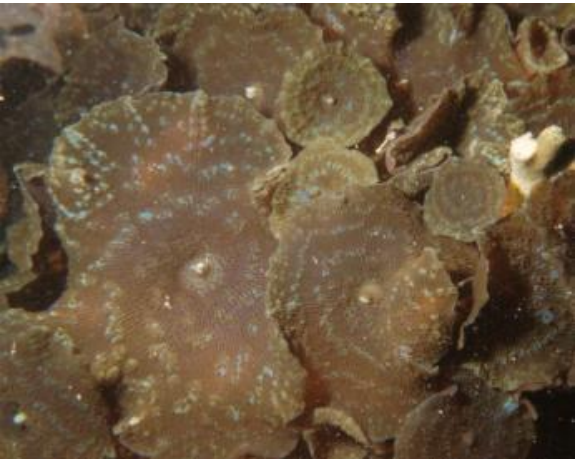
Zoanthid

Zoanthids are colonial anemone-like animals that lack the hard skeletons of stony corals.

Benthic cover

Other

Corallimorphs



A sea anemone-like cnidarians growing invasively at Palmyra Atoll. Also seen at Howland, Baker, Kingman, and Tutuila.

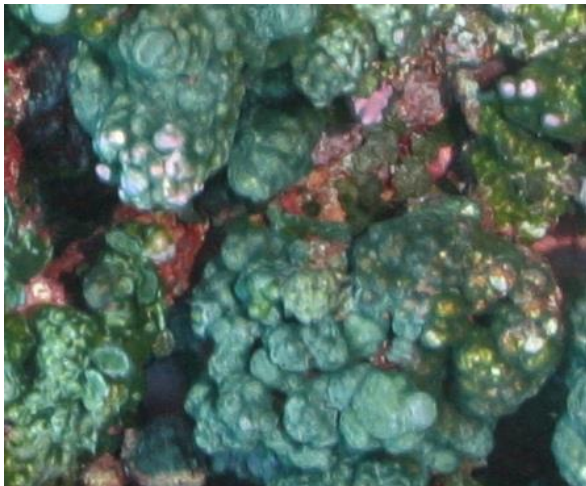
Benthic cover

Other

Tunicate

Tunicates are solitary or colonial animals and may look similar to sponges.

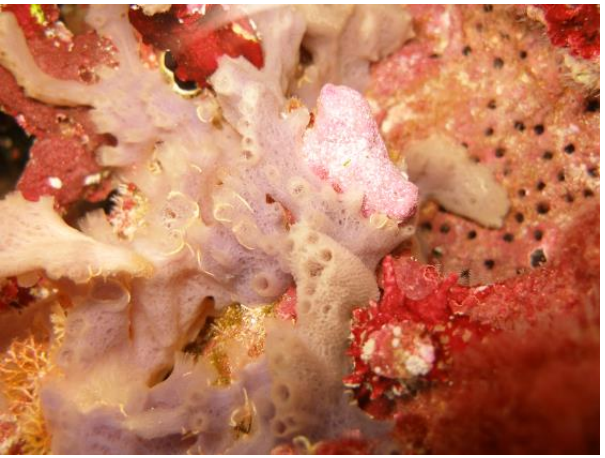
One invasive form (at right) is sometimes observed overgrowing reefs at Swains Island.



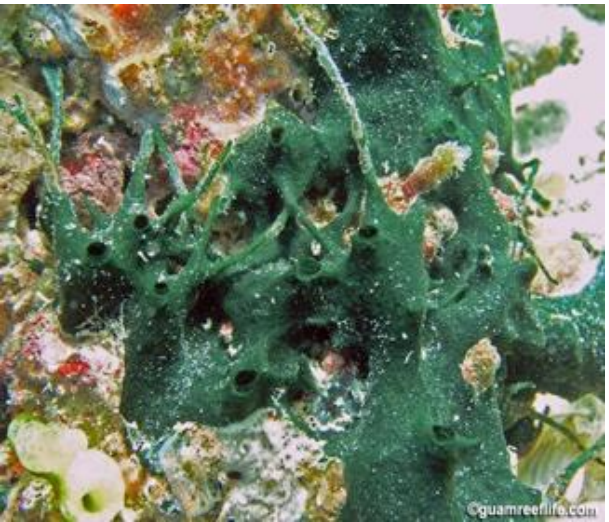
Benthic cover

Other

Sponge



Sponges have many colors and morphologies, with the encrusting form the most commonly seen in the regions CREP surveys.



Benthic cover

Giant clams

Other

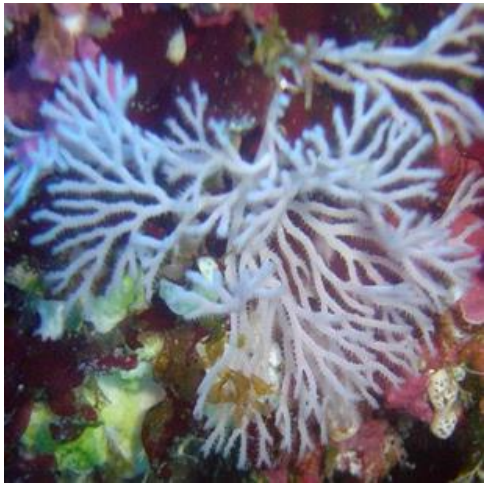
Anemones

Benthic cover

Other

Bryozoans

Bryozoans are tiny colonial animals that may look like algae or encrusting corals.



Benthic cover

Telling apart one category from another:

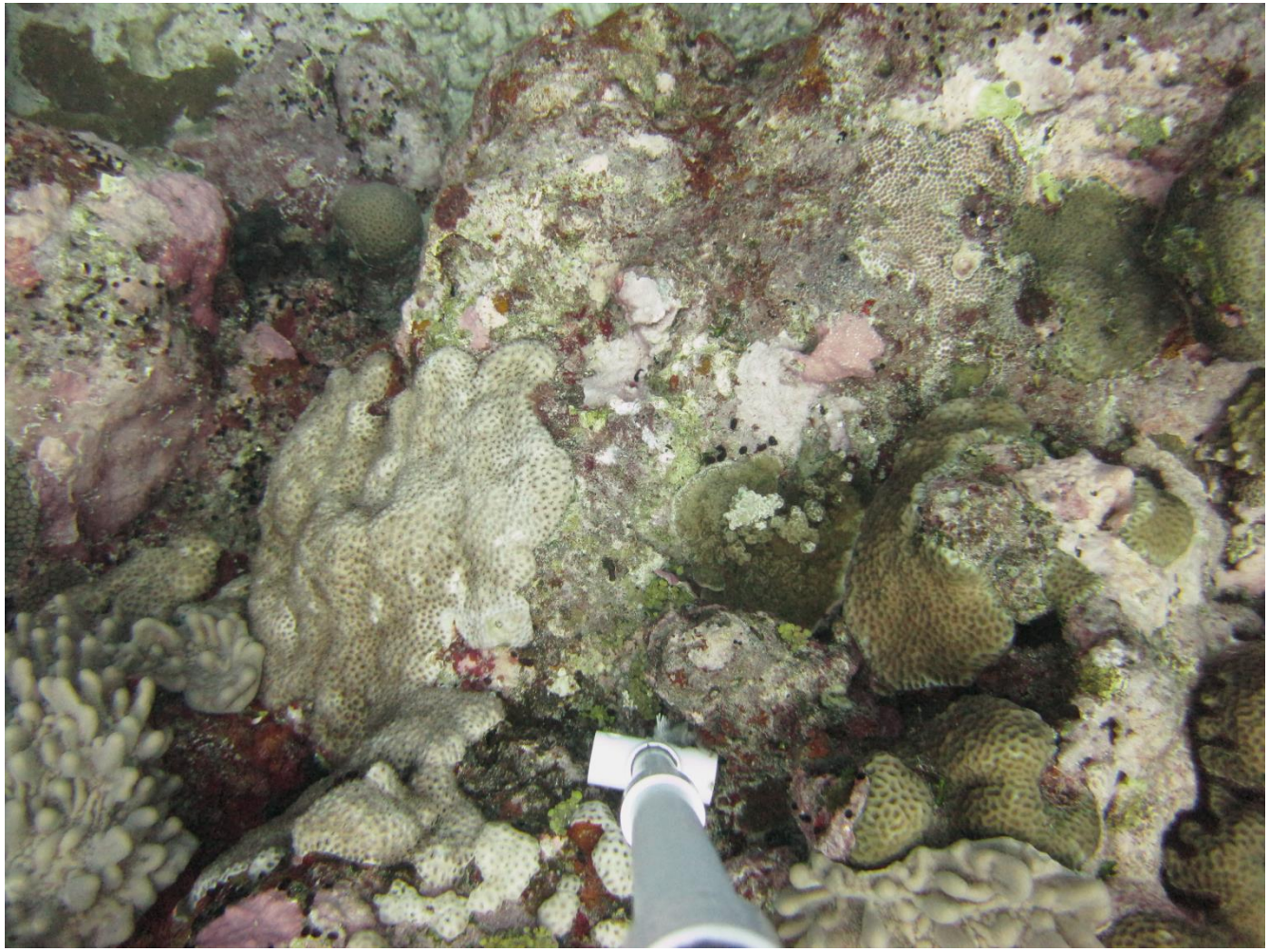
Trouble organisms

Some of the organisms in different categories may look alike, make sure you know the differences.

Most hard corals easy to distinguish, though some encrusting morphologies (*Isopora, Astreopora, Montipora, Leptoseris*) or corals with long polyps (*Euphyllia, Alveopora, Goniopora*), may look like zoanthids, CCA, or even anemones.

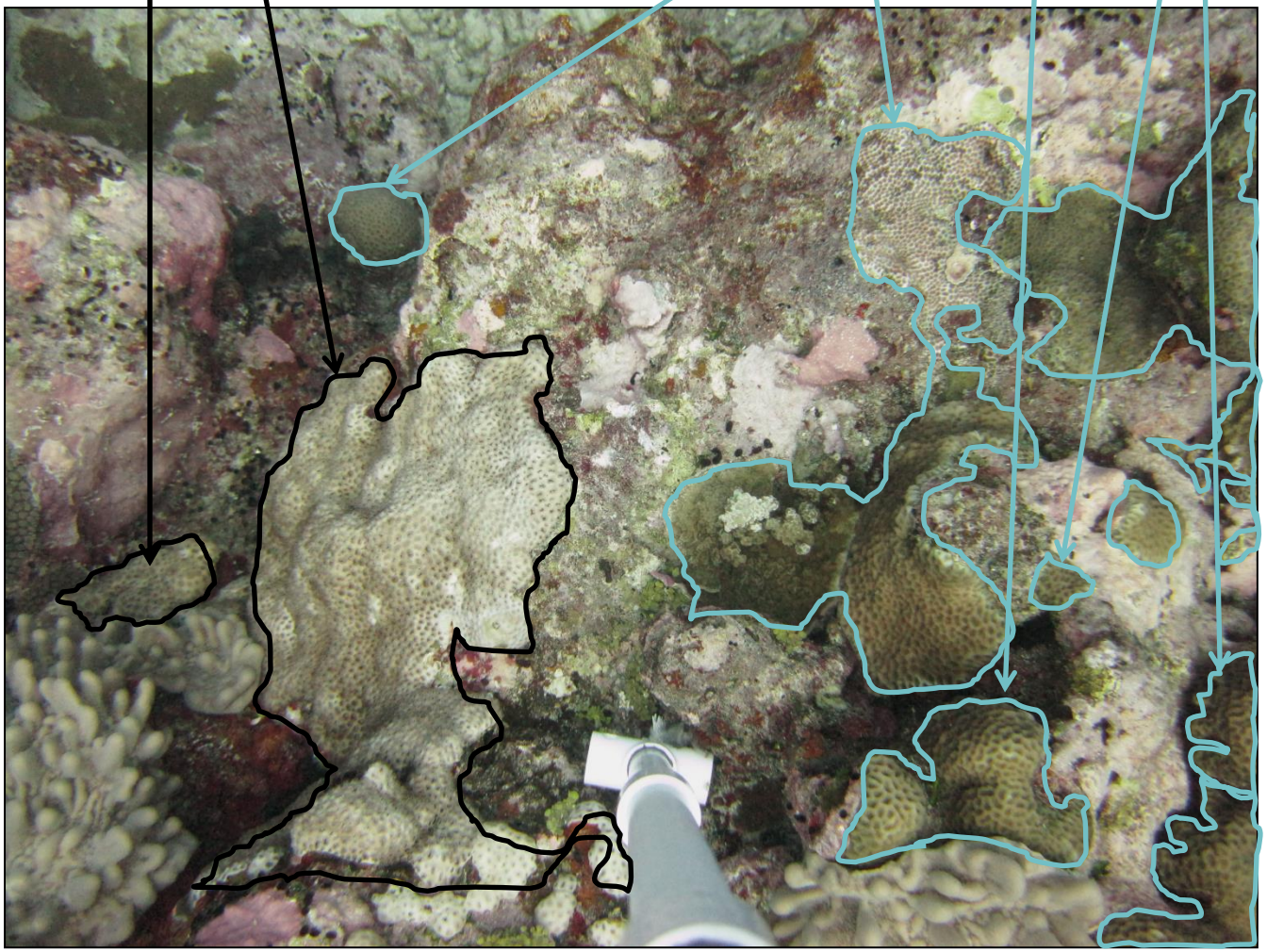
Benthic cover

Zoanthid (Other) vs Hard Corals



Benthic cover

Zoanthid (Other) vs Hard Corals



Benthic cover

Hard Corals vs Anemones (Other)

Euphyllia sp.

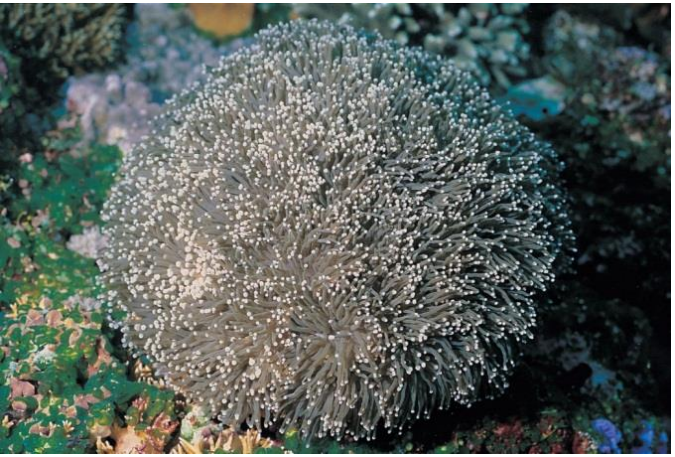
Plerogyra sp.

(Bubble corals)

Entacmaea
(bubble-tip anemone)

Benthic cover

Hard Corals vs Anemones (Other)



Euphyllia glabrescens

Heteractis

Benthic cover

Hard Corals **vs** Soft Coral (Other)

Goniopora/Alveopora spp.

Cladiella

Dendronephthya

Benthic cover

Hard Corals **vs** Corallimorph (Other)

Polyps extended

Polyps retracted

Lobophyllia spp.

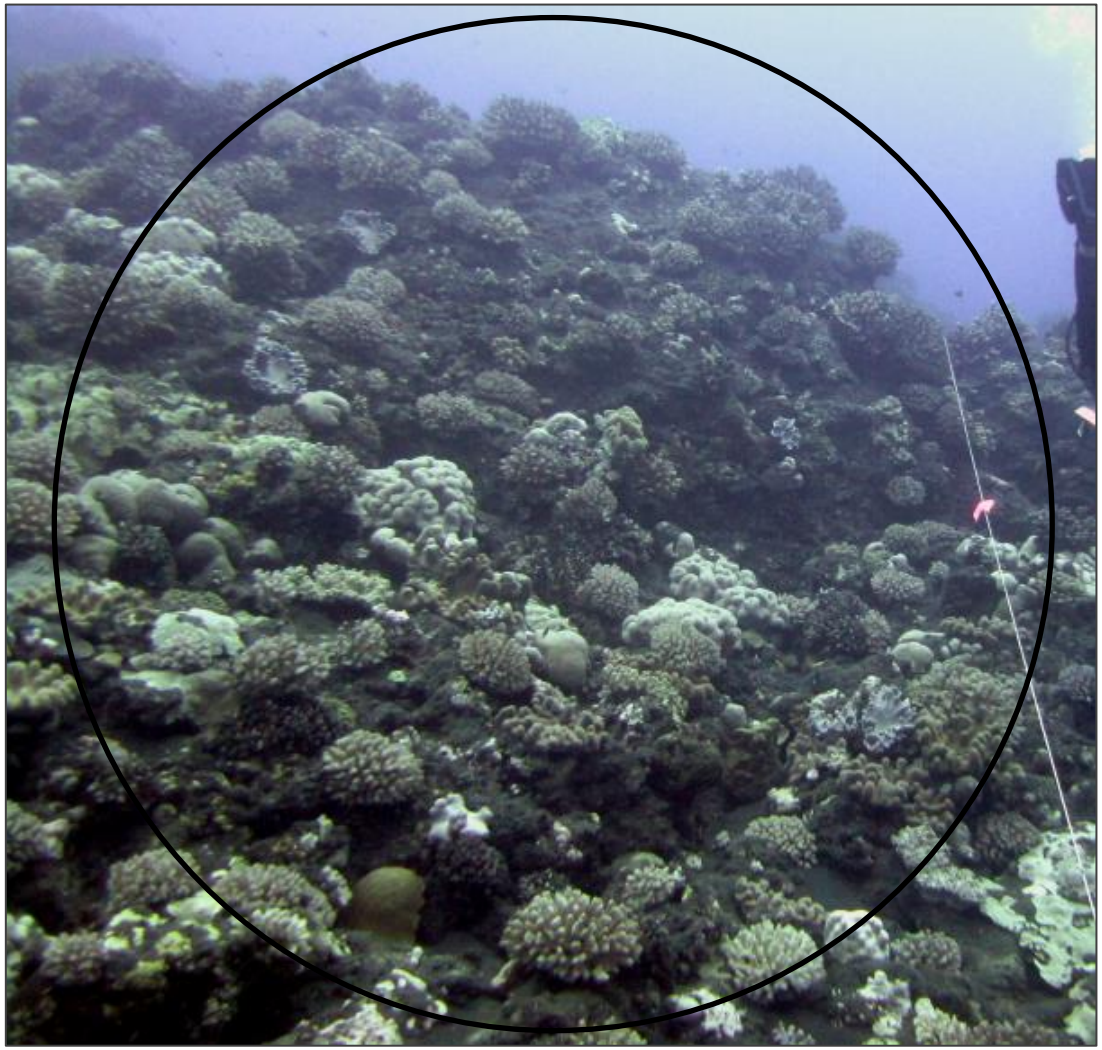
Benthic cover

Hard Corals

vs

(CCA)

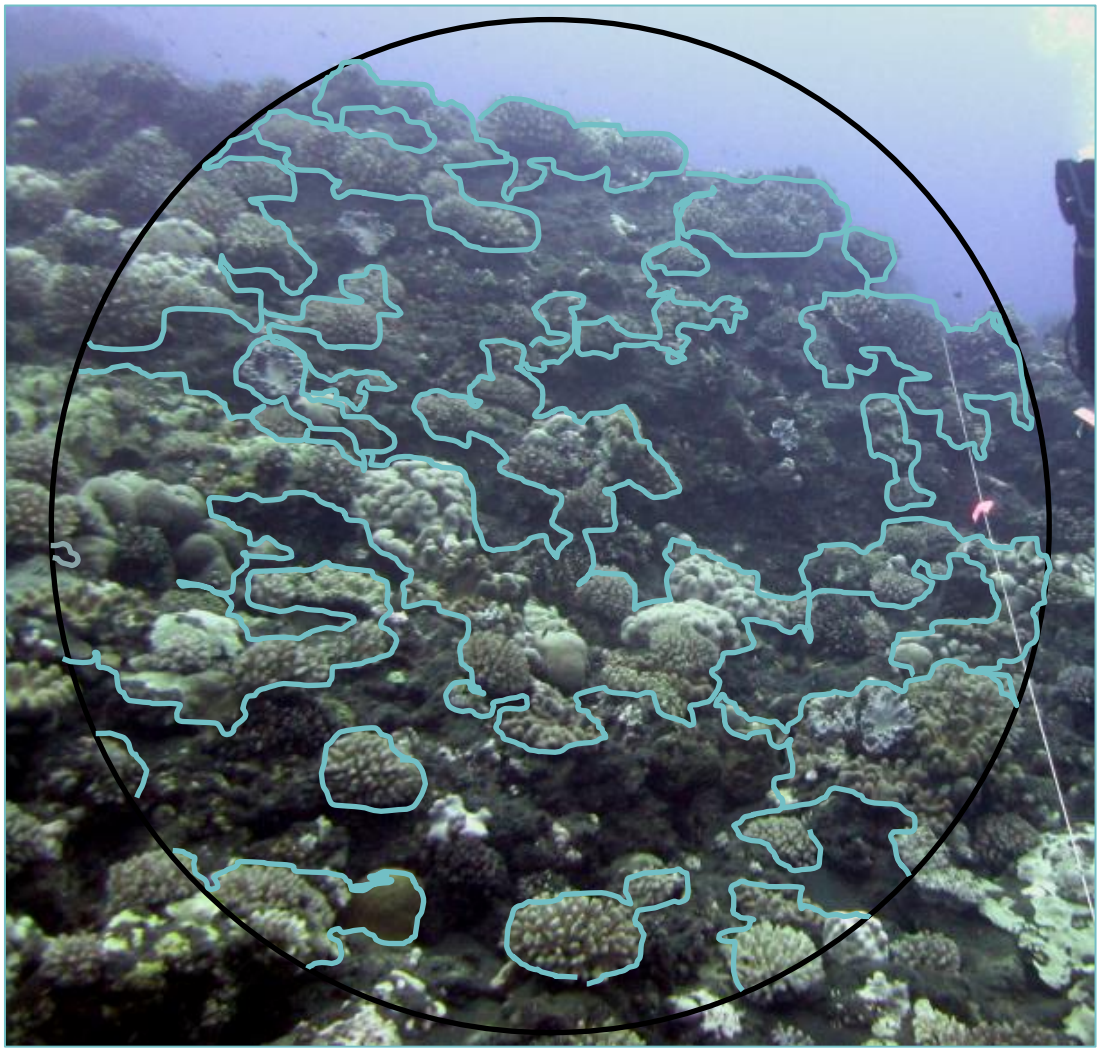
Benthic cover



Estimating benthic cover

From the center of your cylinder, rotate slowly and concentrate on each category one at a time, estimating how much of it there is (% of cylinder).

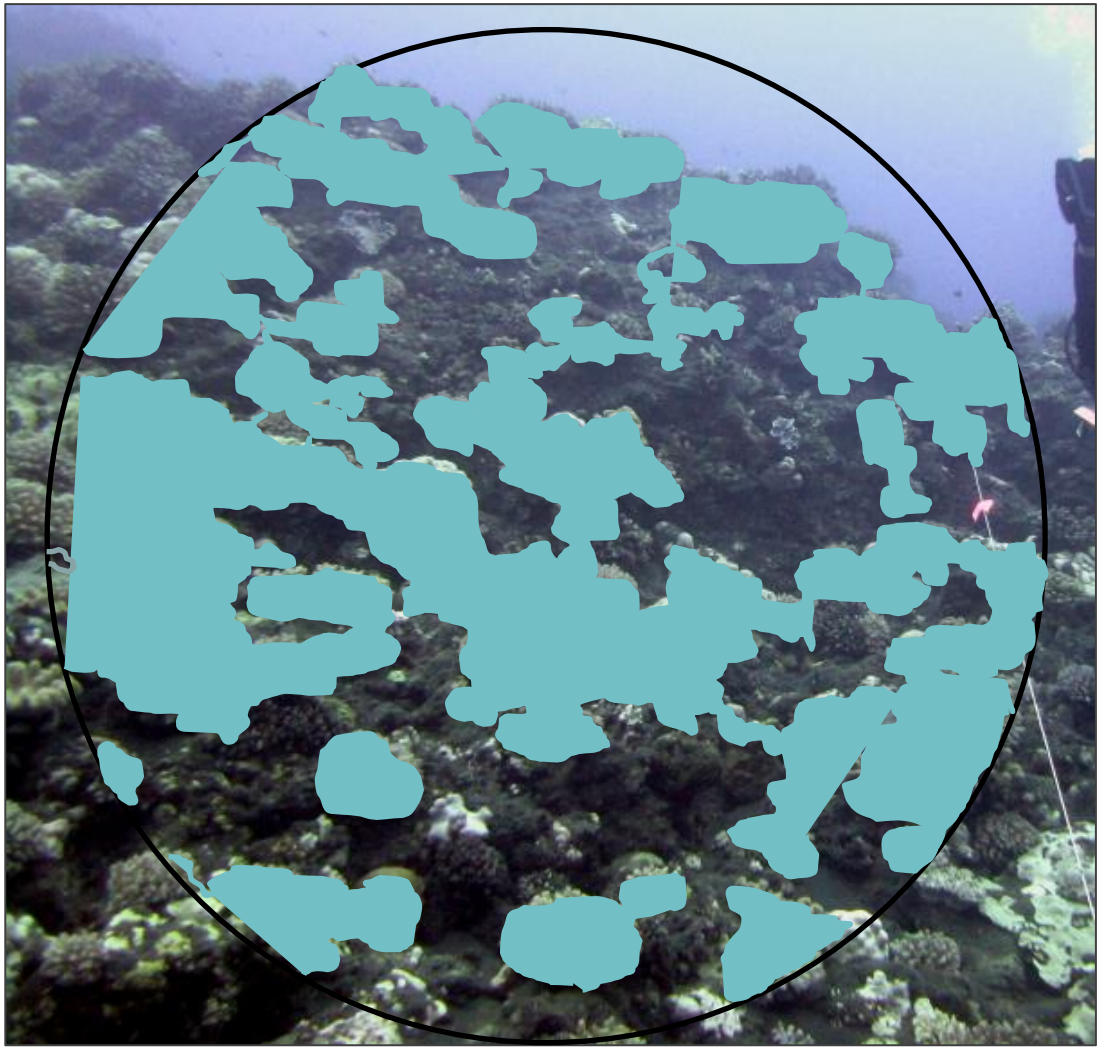
Benthic cover



A good rule of thumb is to start with **Hard Coral**.

First, identify where all the coral is in your cylinder.

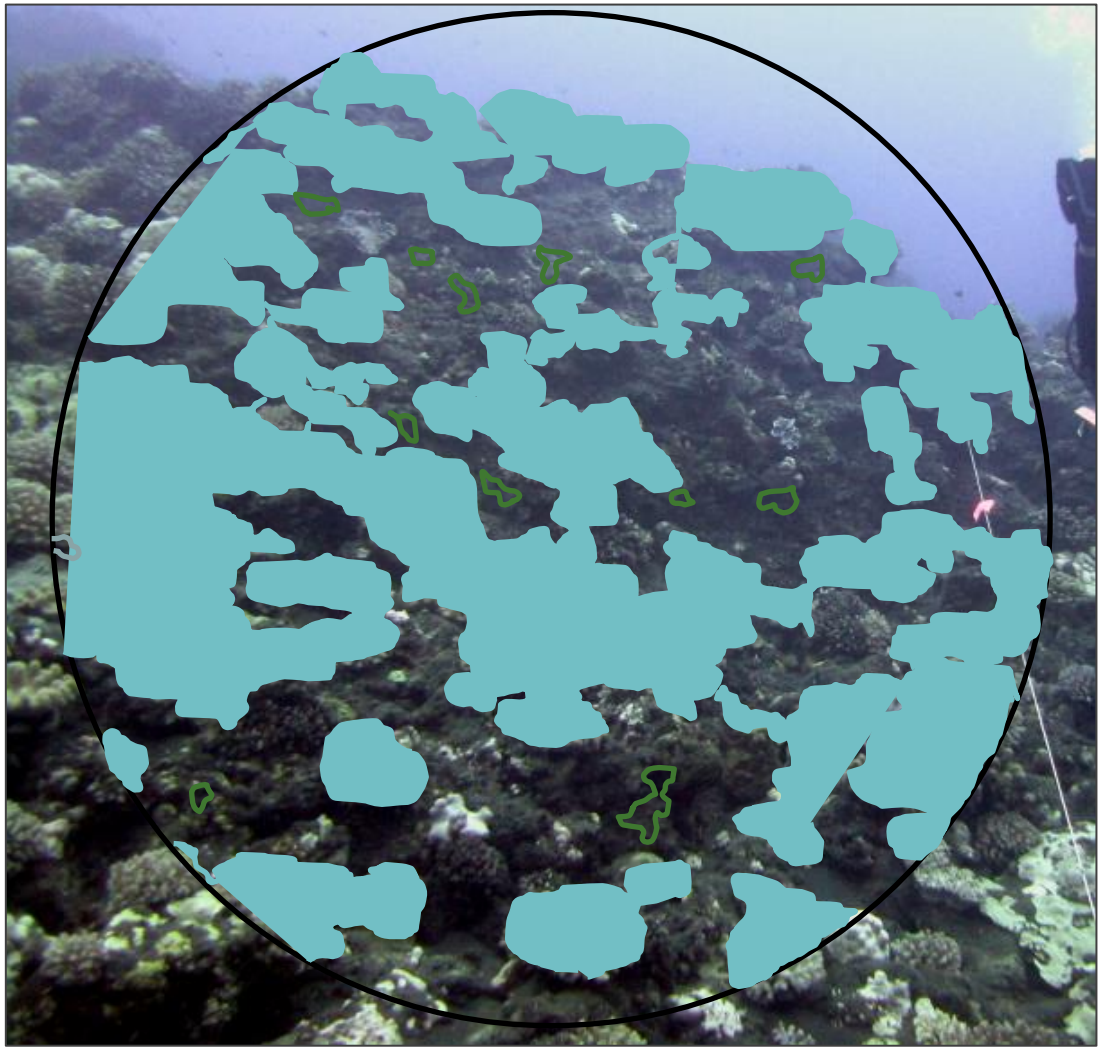
Benthic cover



Then, imagine how much space it takes up and estimate that %.

Coral _50_ %

Benthic cover

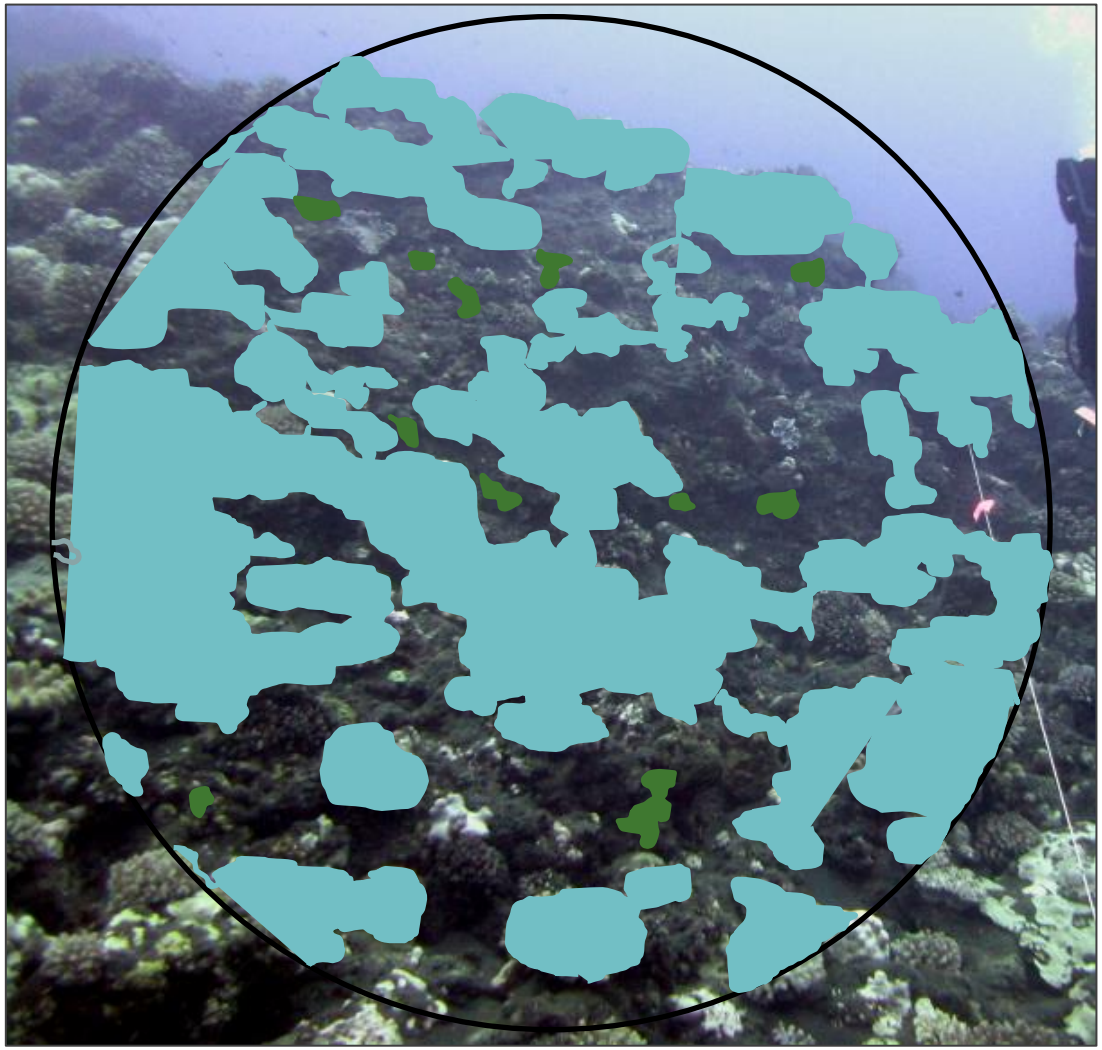


Do the same thing for **Upright Macroalgae**; find where it is in your cylinder…

Coral **50%**

Uprght MA ___

Benthic cover

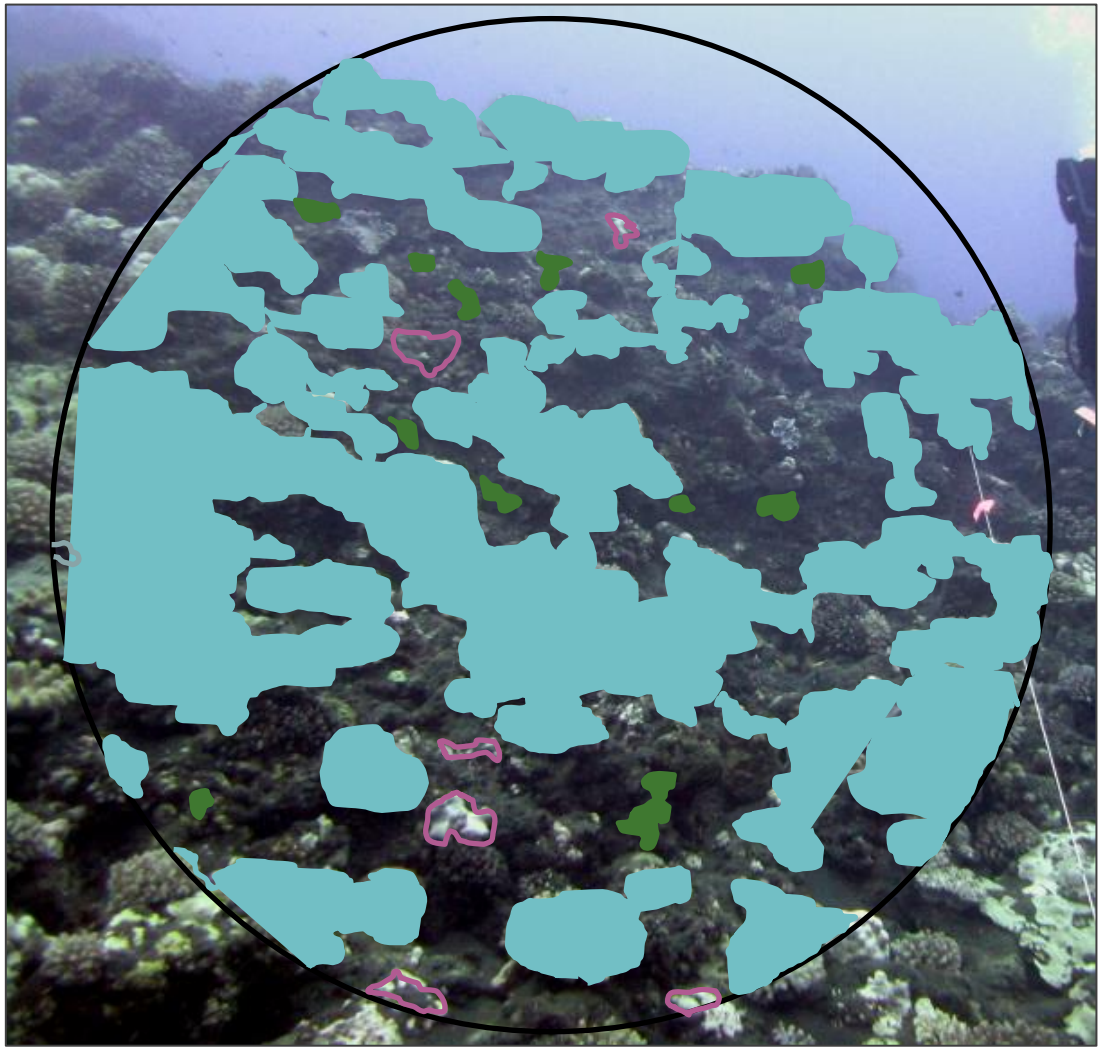


Imagine how much space it takes up and estimate that %.

Coral **50%**

Uprght MA **2%**

Benthic cover



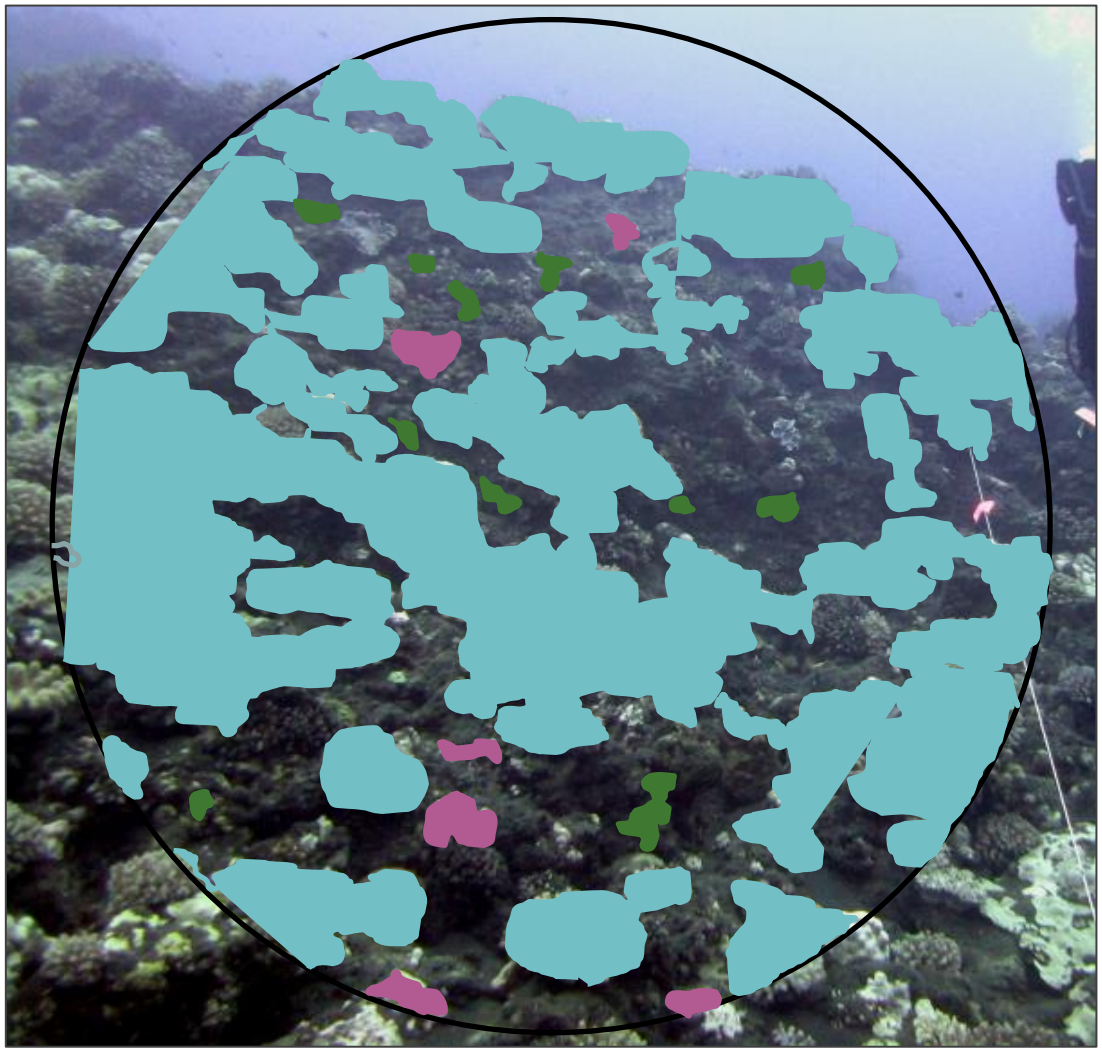
Do the same for **CCA**…

Coral **50%**

Uprght MA **2%**

CCA ___

Benthic cover

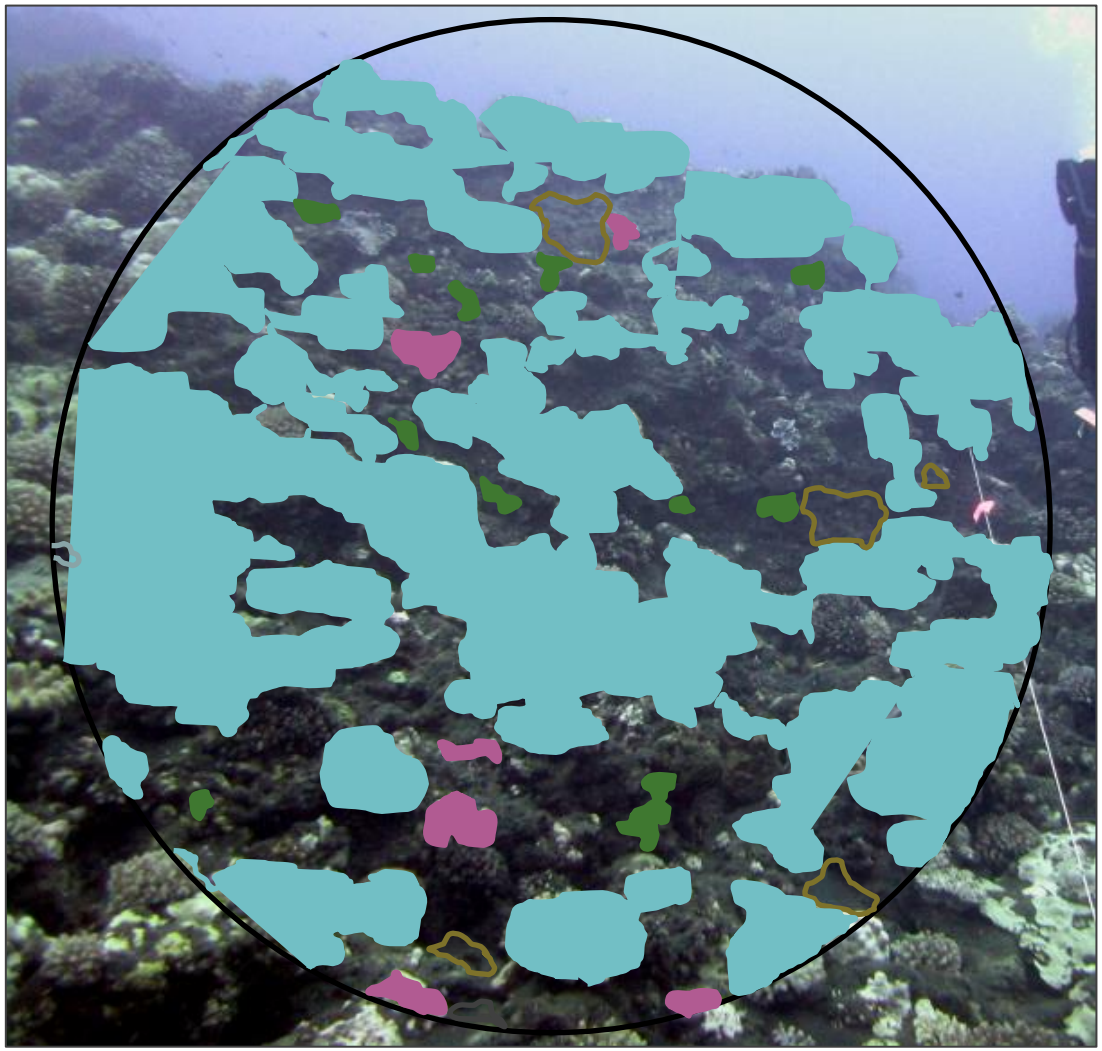


Coral 50%

Uprght MA 2%

CCA 2%

Benthic cover



And **Sand**.

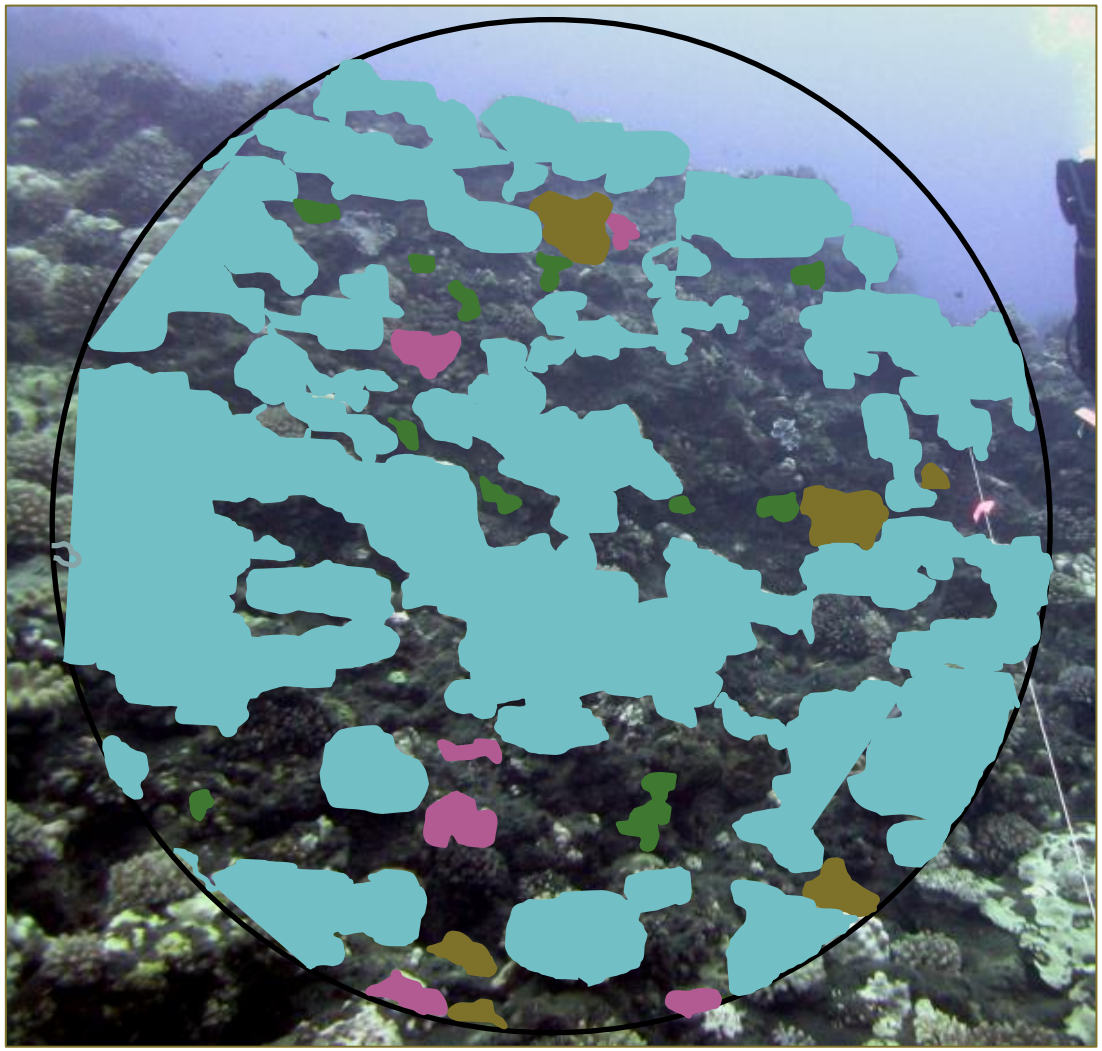
Coral **50%**

Uprght MA **2%**

CCA **2%**

Sand ___

Benthic cover



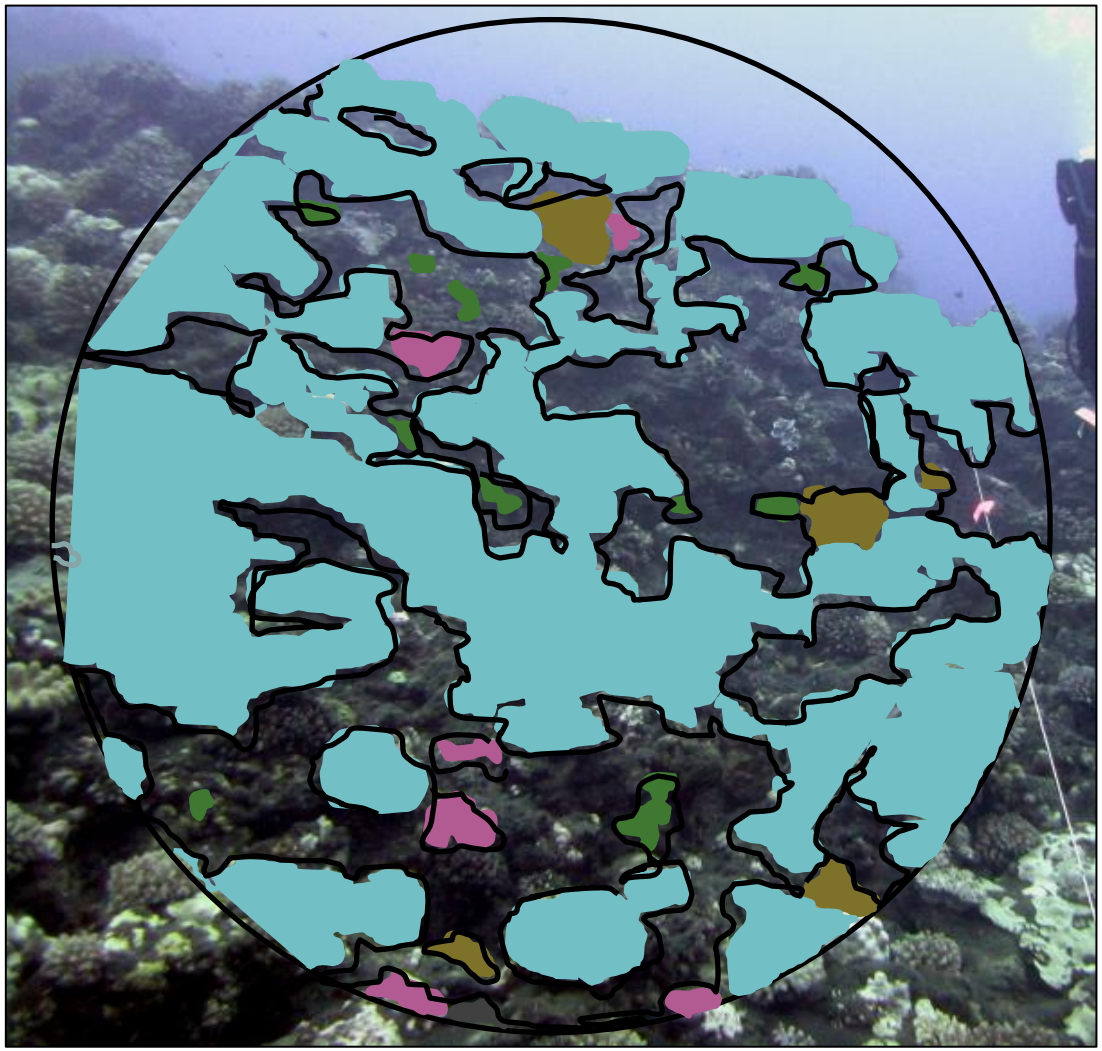
Coral 50%

Uprght MA 2%

CCA 2%

Sand 2%

Benthic cover



Everything that's left in your cylinder is **Other**, including turf, soft coral, cyanobacteria, zoanthids, etc.

Coral 50%

Uprght MA 2%

CCA 2%

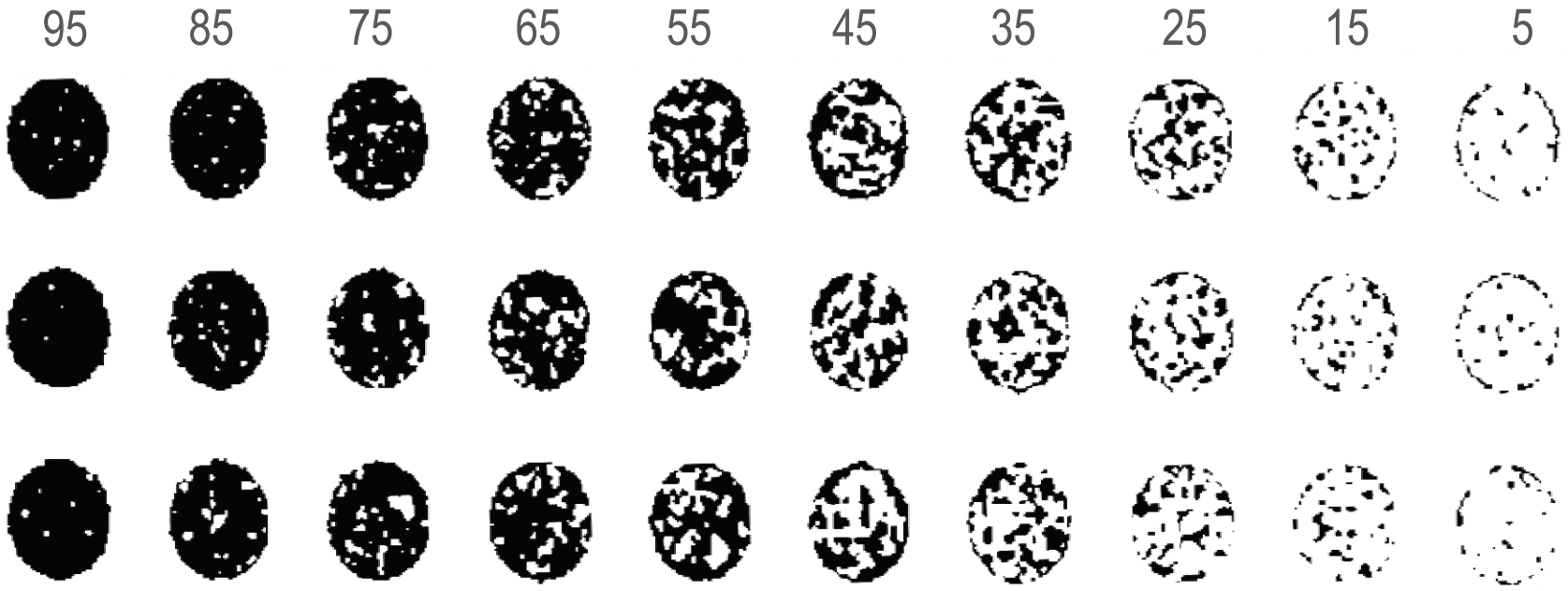
Sand 2%

Other 44%

Benthic cover

% Cover guide

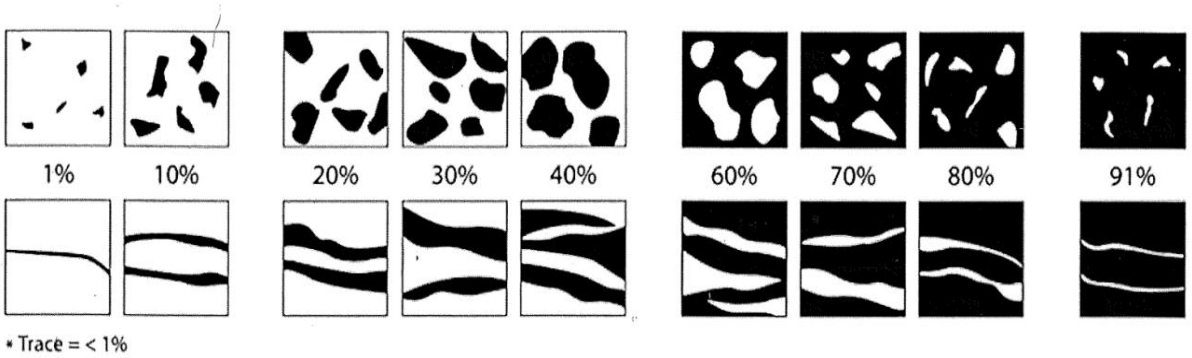
The graphics on this and the following pages can be helpful for practicing % cover estimates.

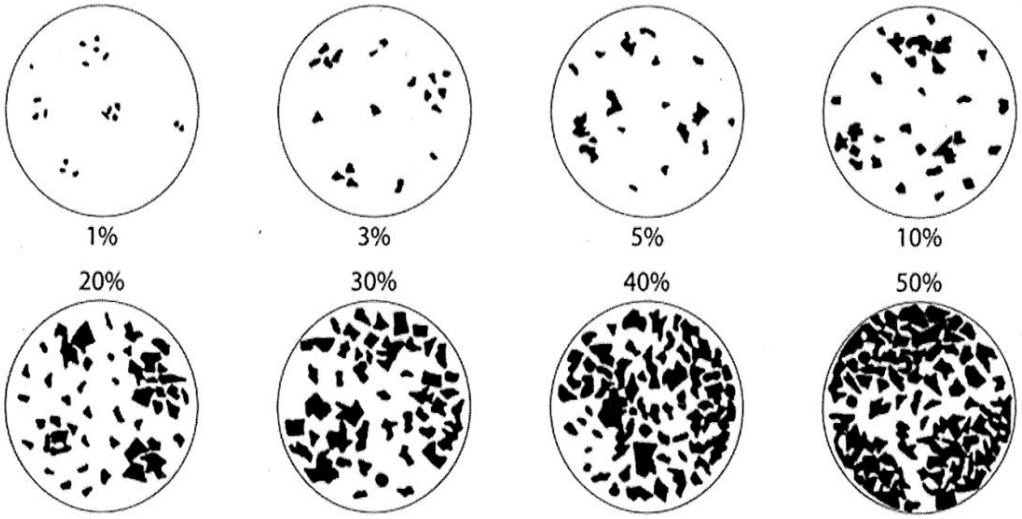


Accessed 10/20/15 from: http://phytosphere.com/treeord/ordprt3c.htm

Benthic cover

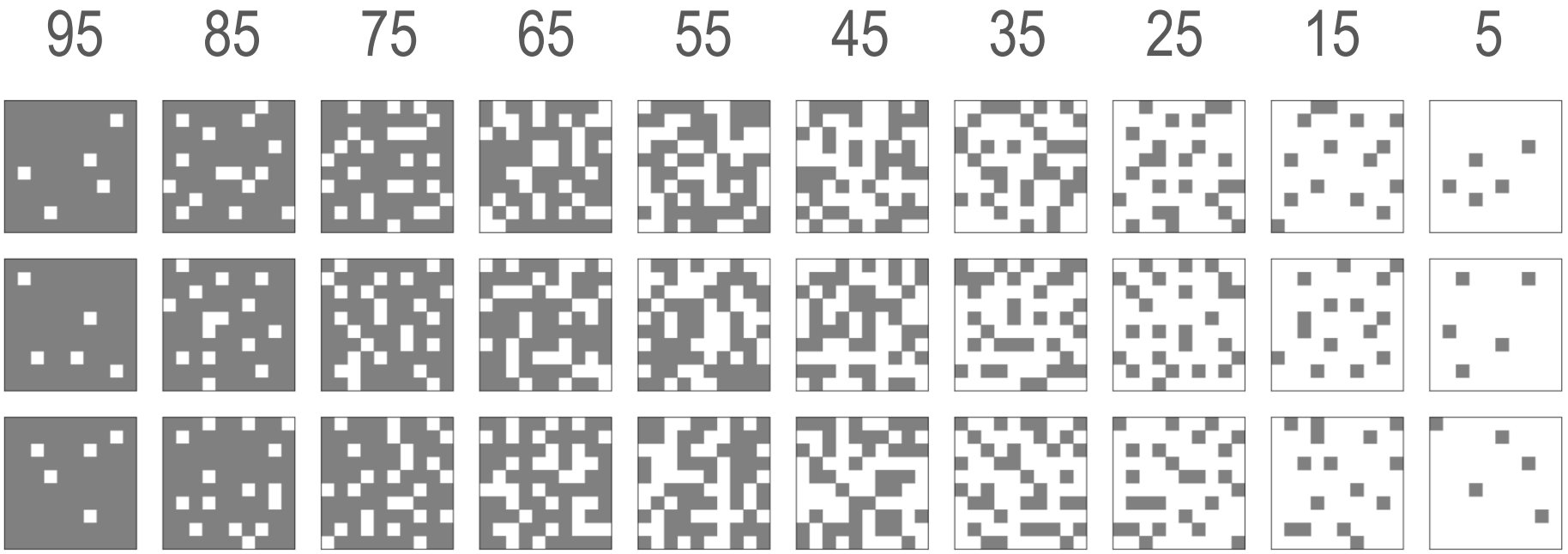
% Cover guide





Benthic cover

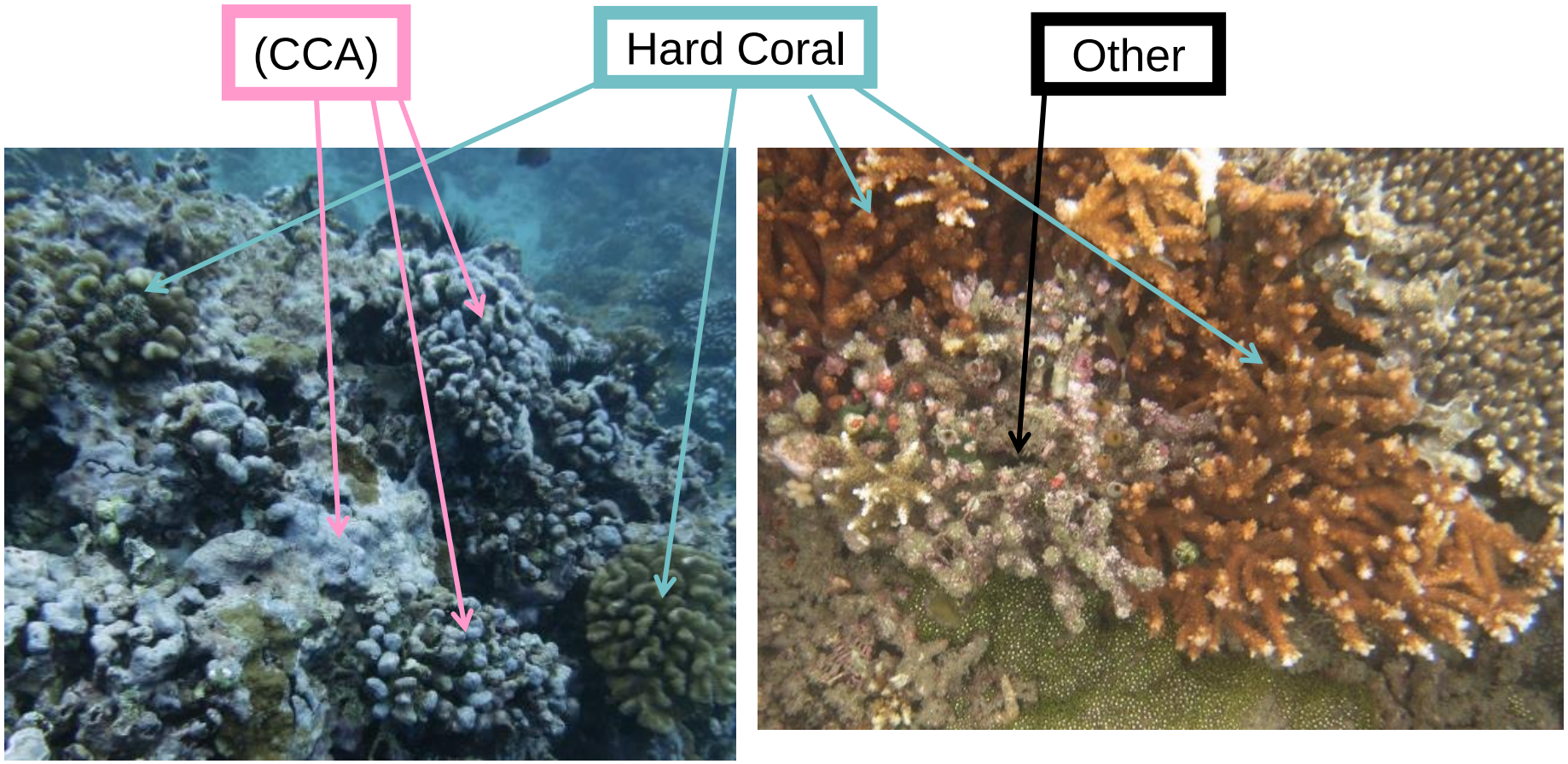
% Cover guide



For additional % cover practice, see the **Percent Cover Practice Slides** under “Other Resources – Study Aids” in the training materials.

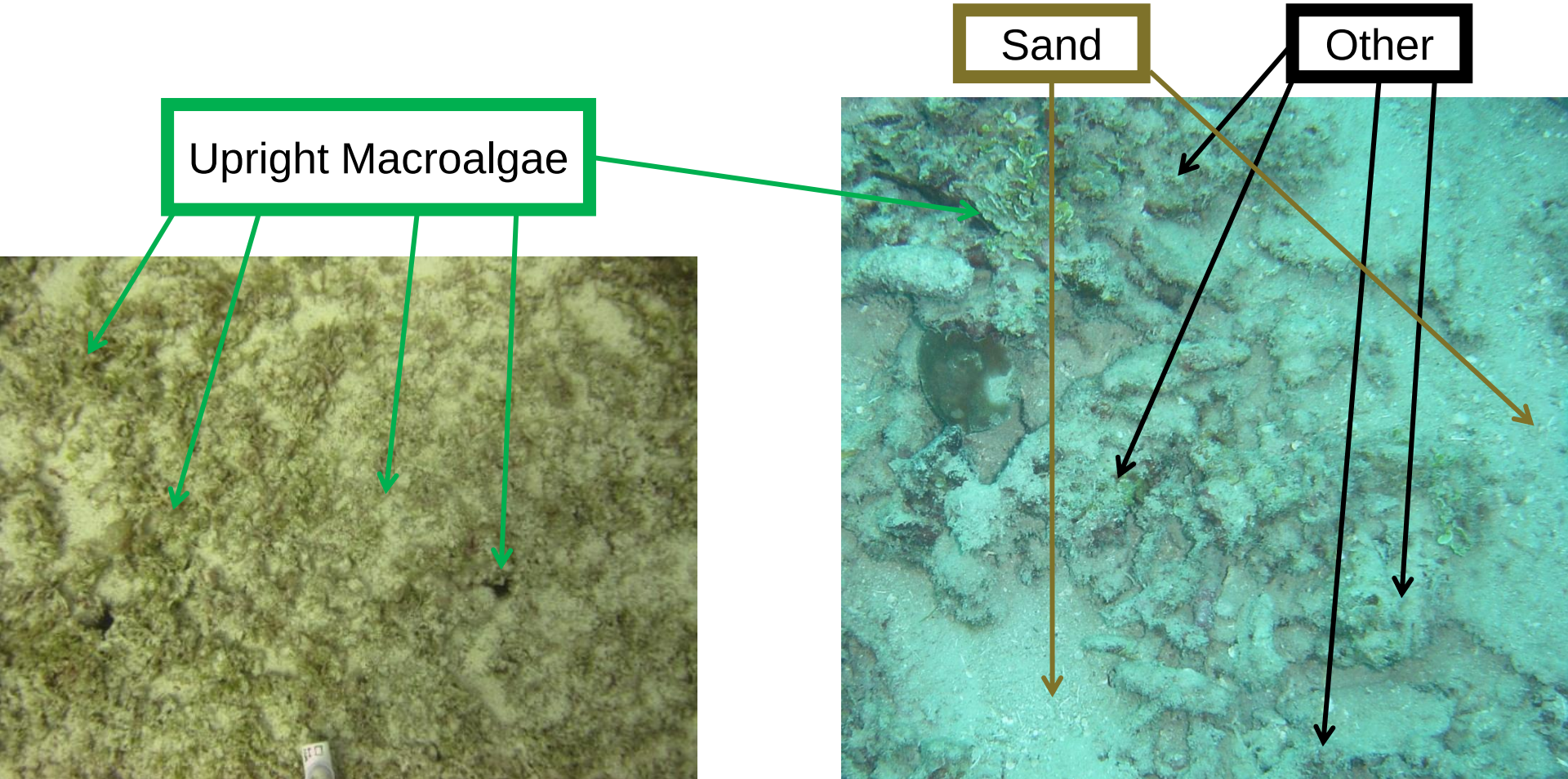
Benthic cover

NOTE: Only the top layer of substrate should be identified. If a coral head is dead, it shouldn't be identified as "Hard Coral," rather whatever is covering it; e.g. CCA or turf ("Other").



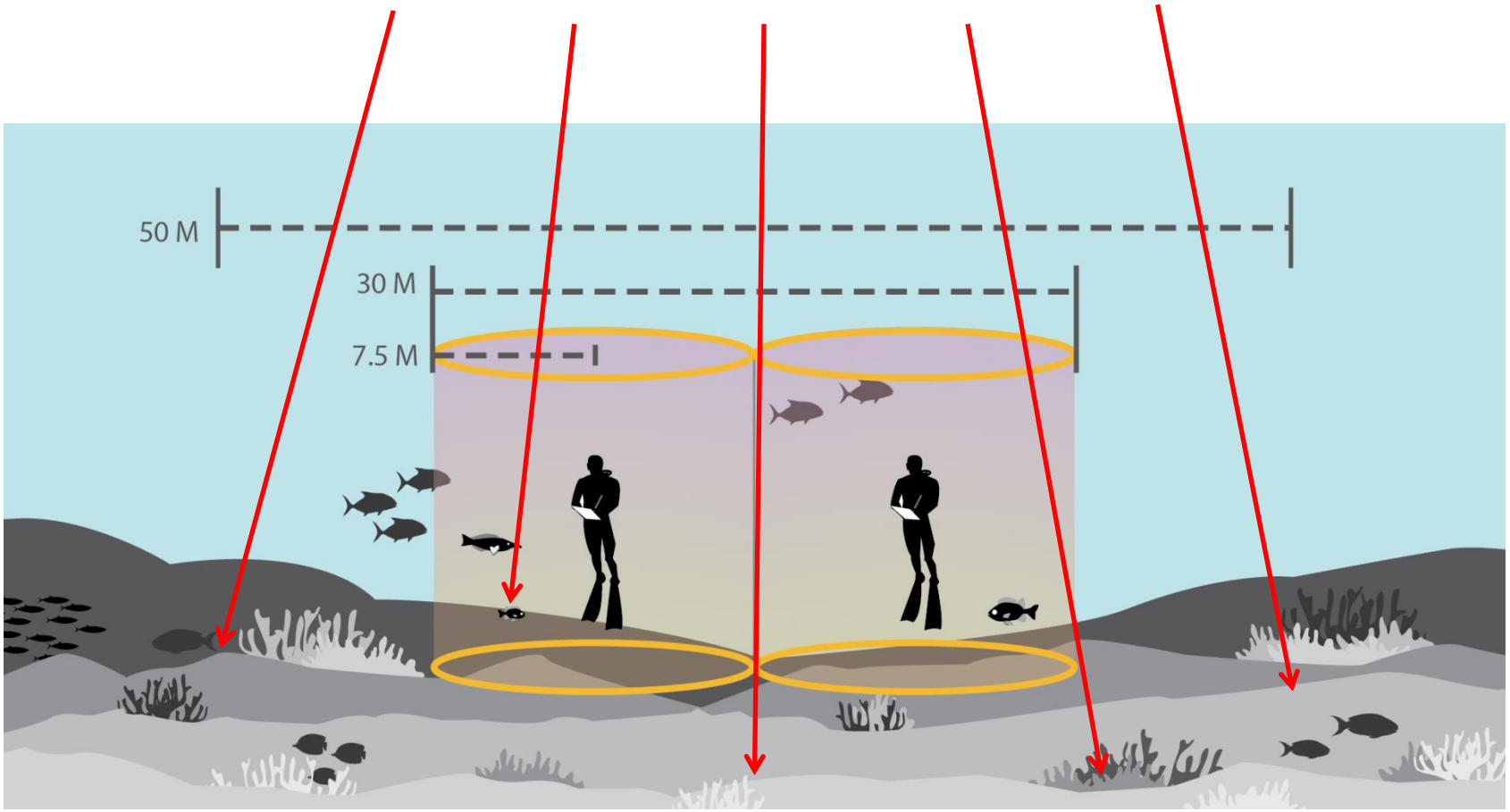
Benthic cover

EXCEPTION: if the top is just a light dusting of sand, then whatever it's covering should be identified. Often it will be OTHER, however, some algae (e.g. *Microdictyon sp*. or *Halimeda sp.*) may appear obscured by sand or turf though should still be identified as Upright Macroalgae.



Habitat type

Describe the general area in and around your cylinders, approximately 50x50m.



Habitat type

- Aggregate Reef
- Aggregate Patch Reef
- Aggregate Patch Reefs
- Pavement
- Pavement with Patch Reefs
- Pavement with Sand Channels
- Rock/Boulder
- Reef Rubble
- Spur and Groove
- Sand with Scattered Coral/Rock

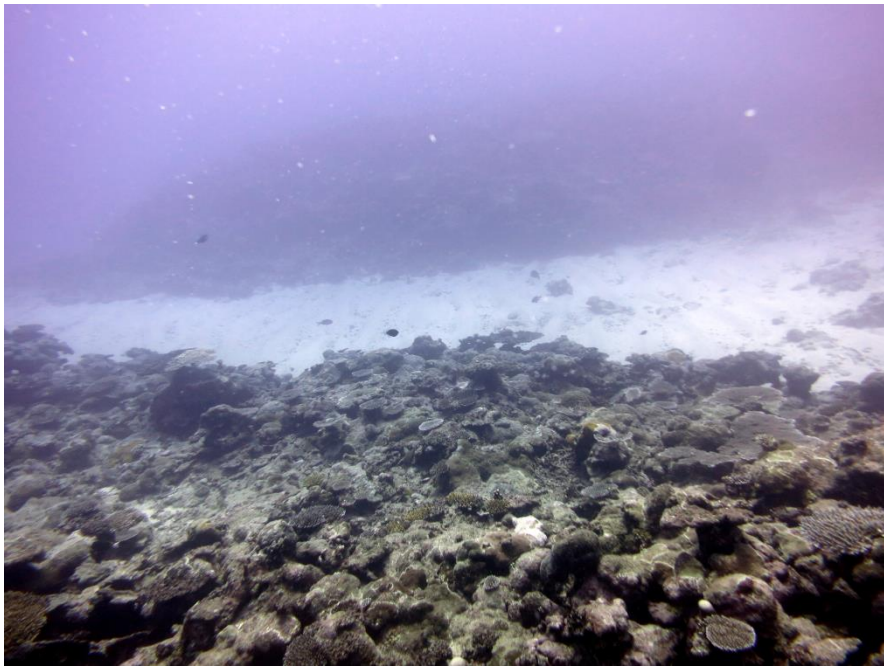
Habitat type √	
(Encompasses entire area)	
1. AGg Reef	6. Pvmnt w/Snd Chnls
2. Agg Patch Reef	7. ROck/Boulder
3. Agg Patch ReefS	8. Reef RuBble
4. PAVmnt	9. Spur And Groove
5. Pvmnt w/Ptch Reefs	10 . Snd w/Sct Coral/Rck

Habitat type

Aggregate Reef:
Hard bottom with coral/carbonate structures.

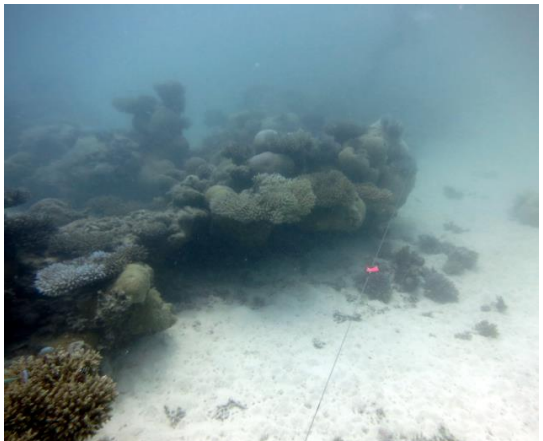
Habitat type

Aggregate Patch Reef:
Coral formations isolated from other coral formations by sand and are larger than or equal to the survey area.



Habitat type

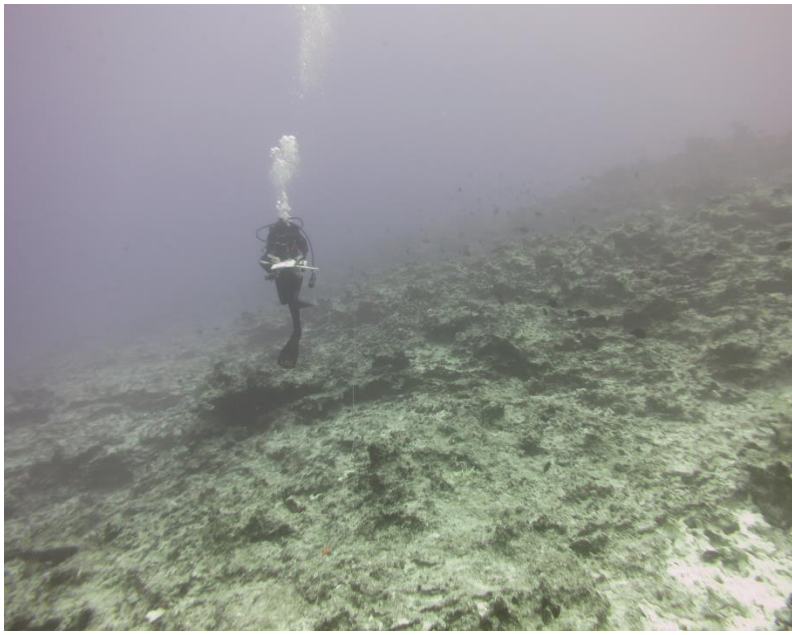
Aggregate Patch Reefs:
a comparatively small assemblage of coral colonies or carbonate formations isolated from other formations by sand or other habitats.

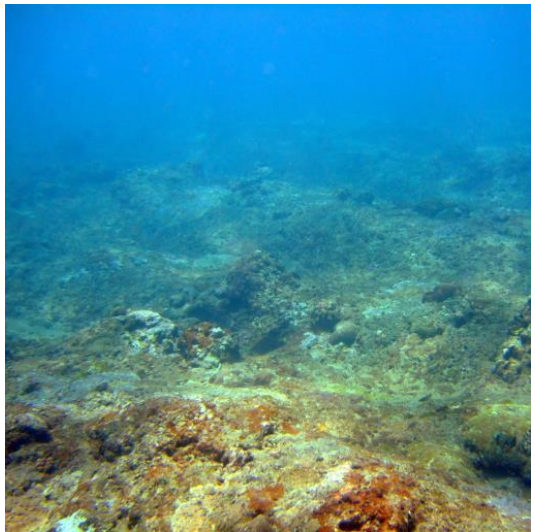


Habitat type

Pavement:

Flat, low relief, consolidated substrate. Typically calcareous and/or basaltic elements.

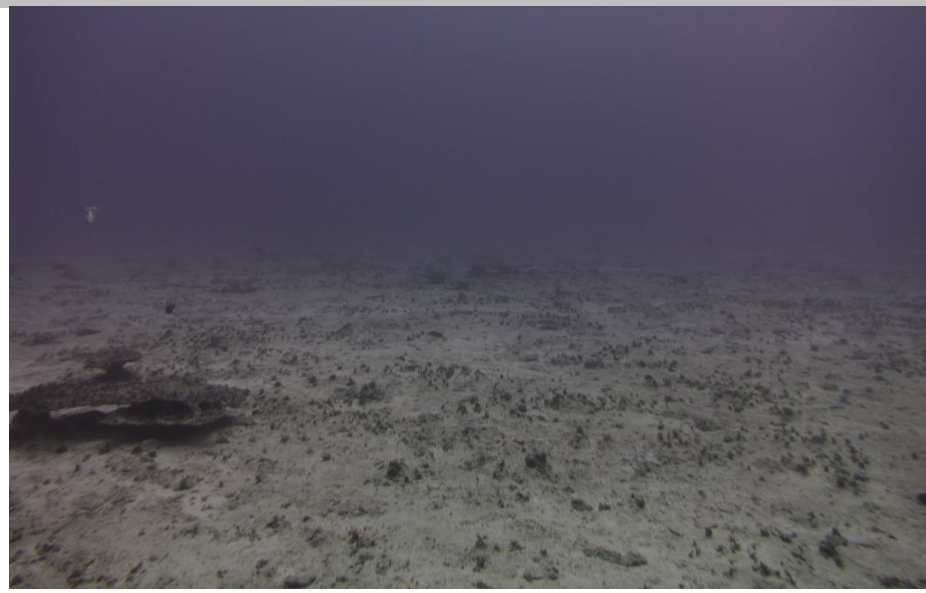


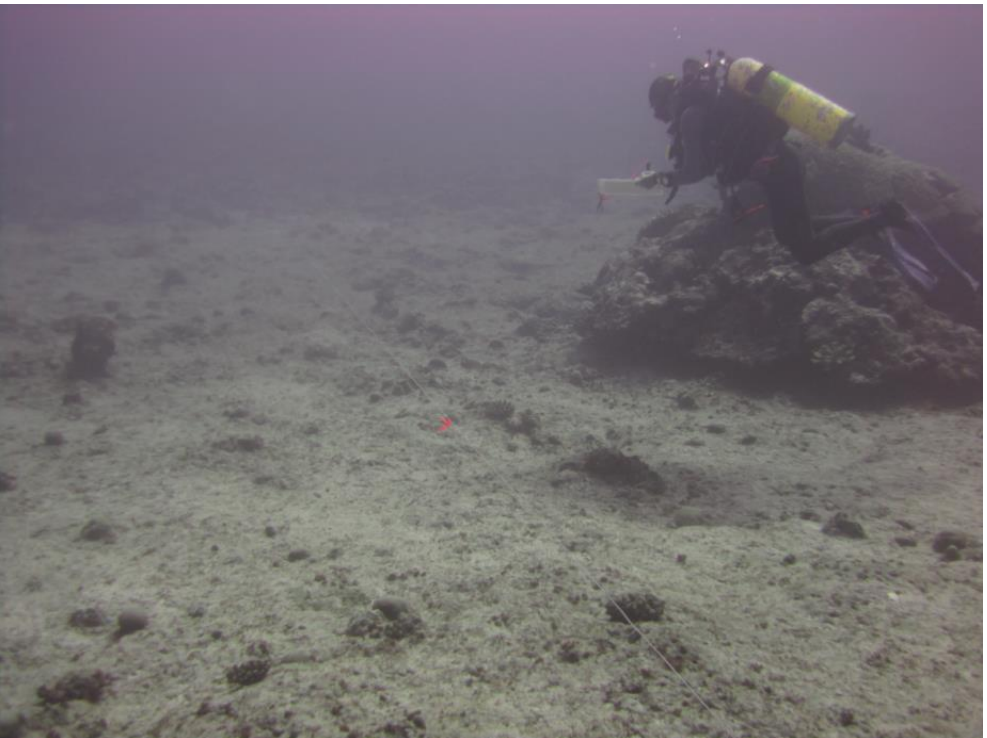


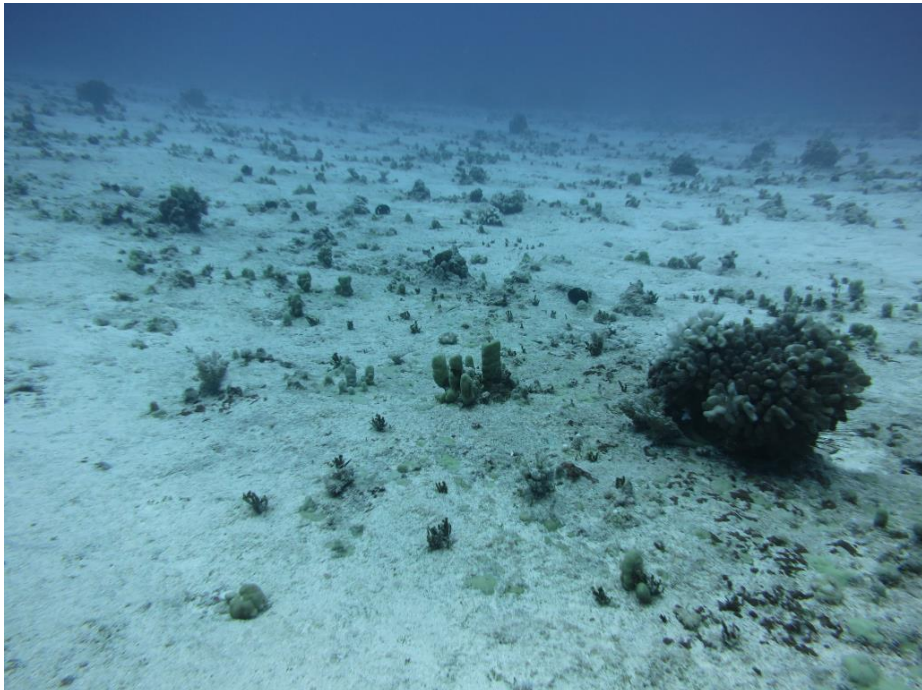
Habitat type

Pavement with Patch Reefs:

Pavement with occasional patch reef formations that make up <10% of the general area.



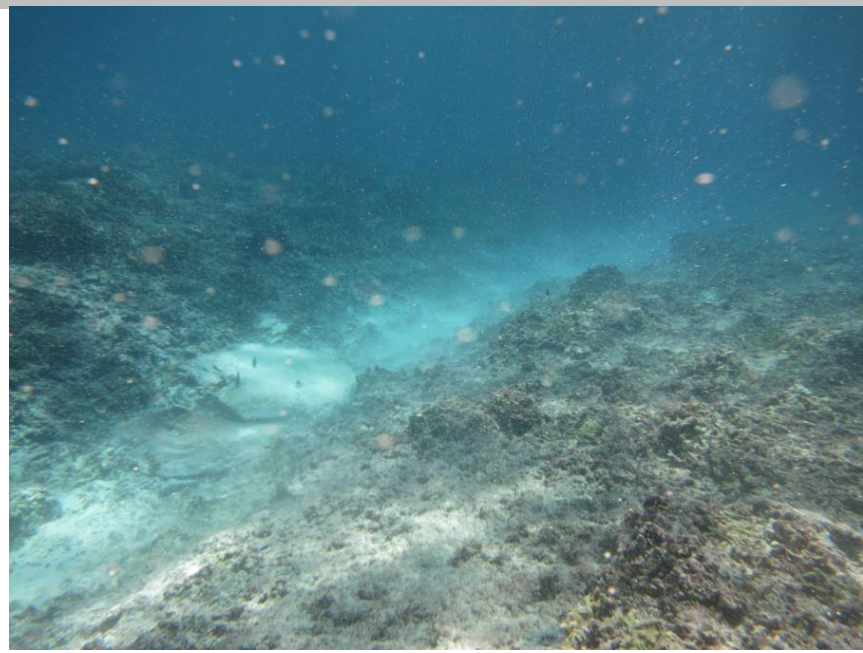


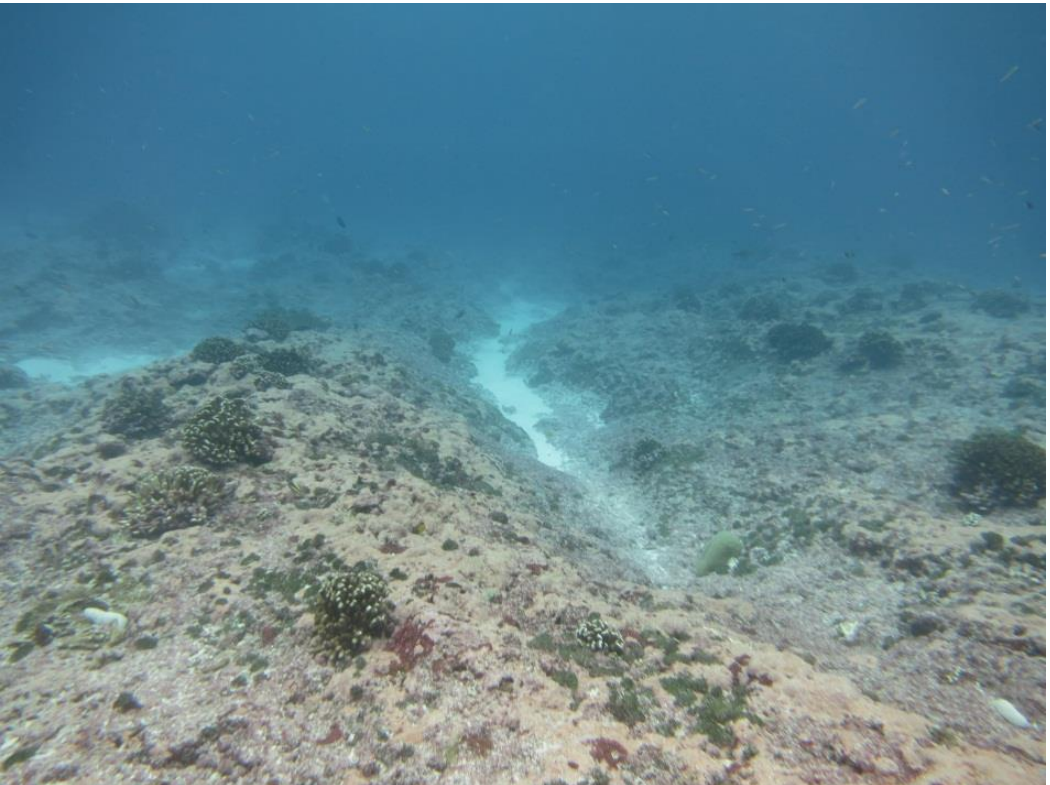


Habitat type

Pavement with Sand Channels:

Pavement with alternating sand/surge channels; typically low vertical relief (<1m).





Habitat type

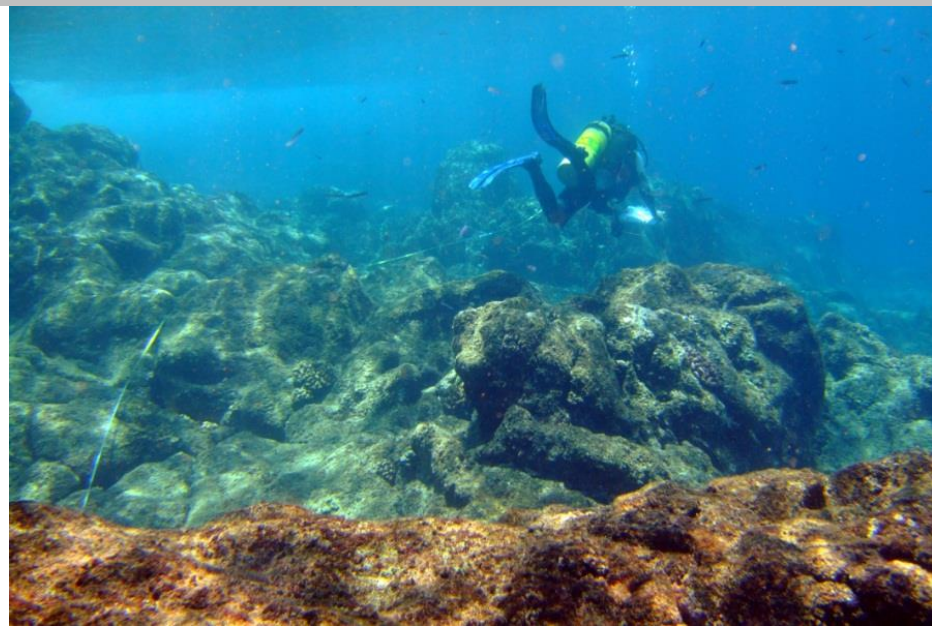
Reef Rubble:

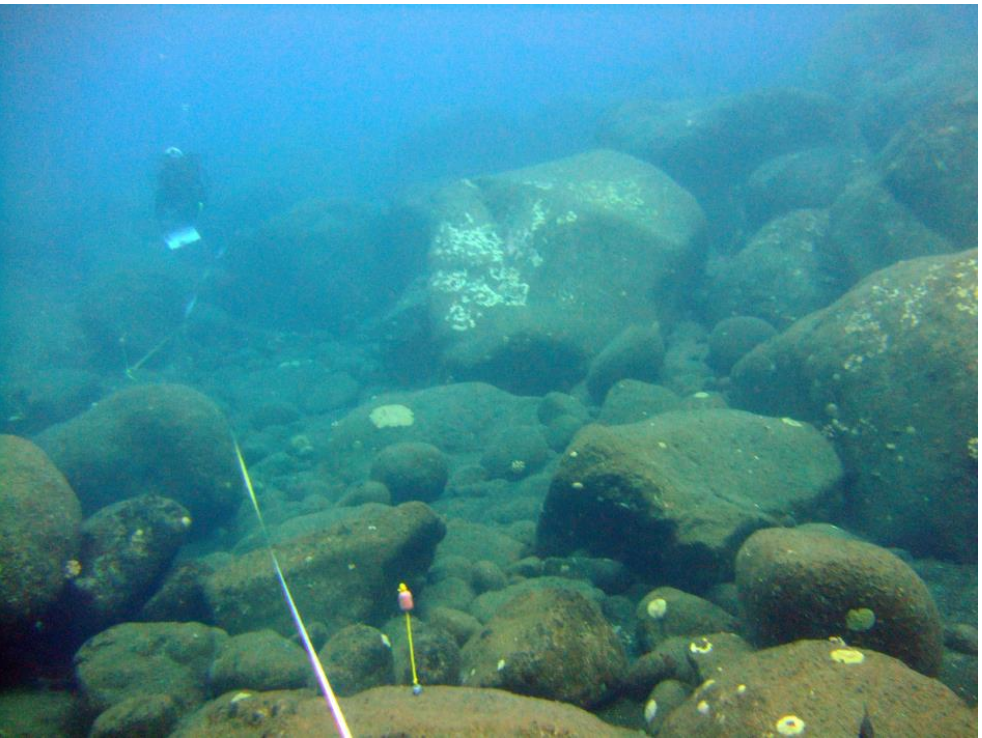
Dead, unstable coral pieces often colonized with macroalgae, crustose coralline algae, turf algae, or small coral colonies.

Habitat type

Rock/Boulders:

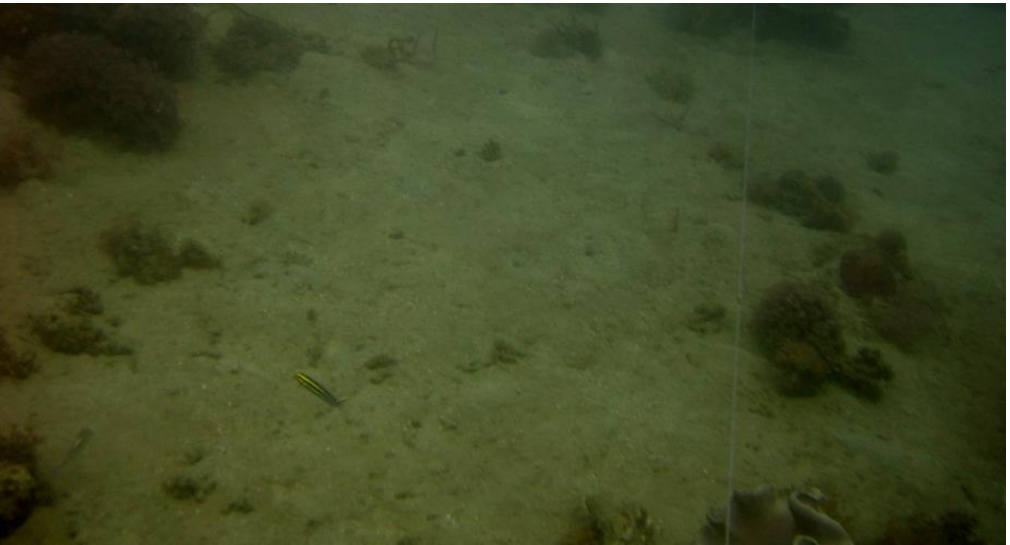
Solid carbonate blocks and/or boulders or volcanic rock.

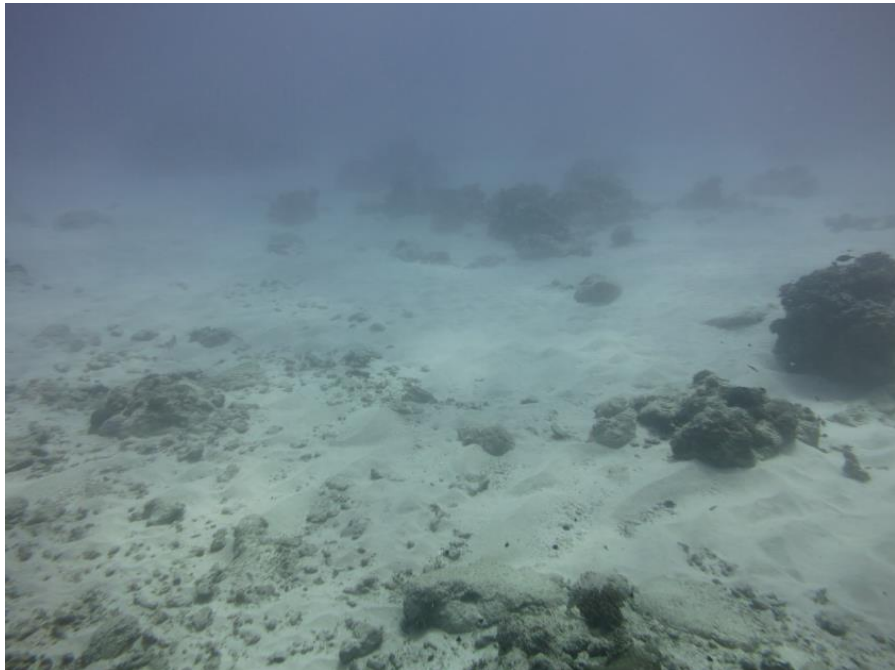




Habitat type

Sand w/Scattered Coral/Rock:
Sand bottom with scattered rocks or small, isolated coral heads that make up <10% of the total area.

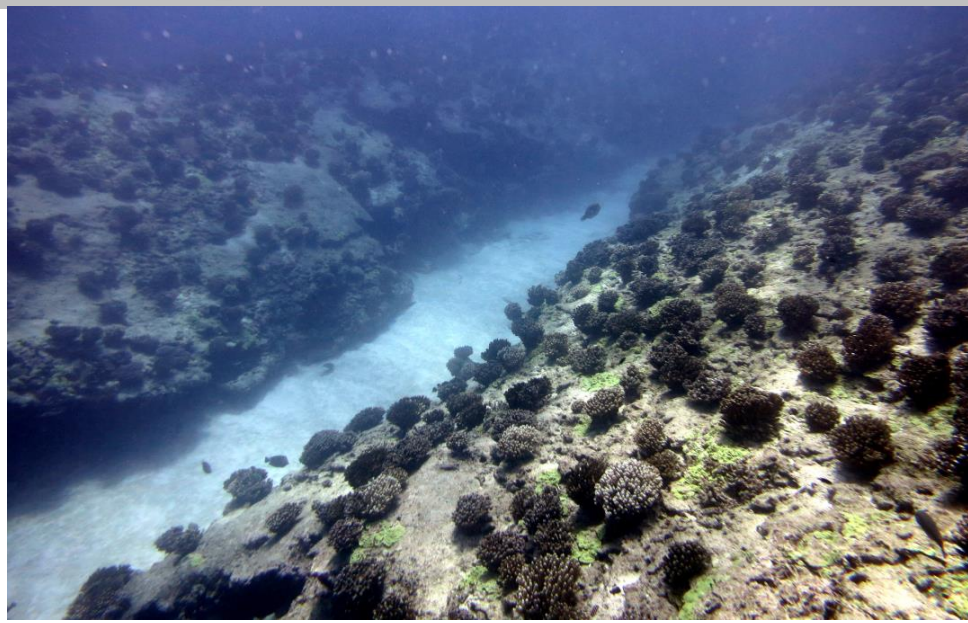


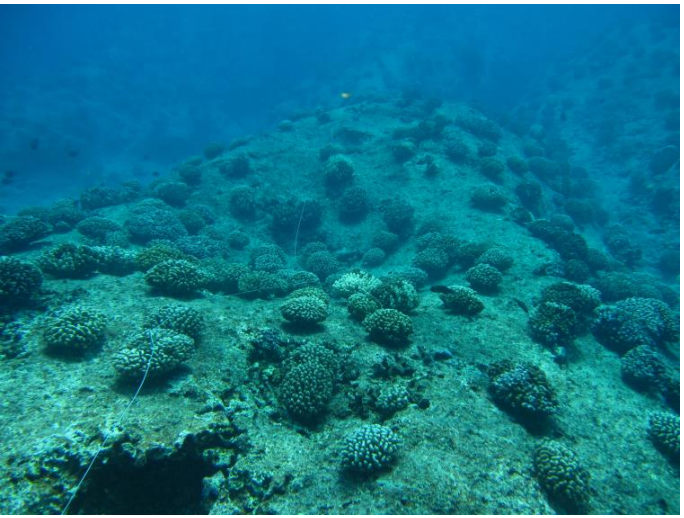


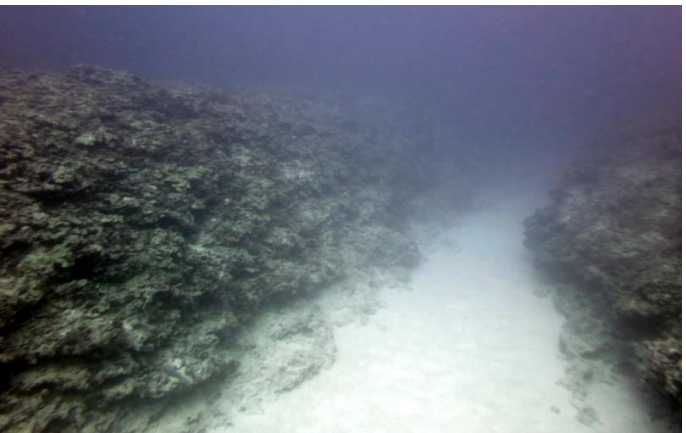
Habitat type

Spur and Groove:

Typically high relief (>1m) with alternating sand and coral formations. Grooves generally 1-5m wide.







Habitat type

Enter on both:

- Data sheet
- Dive/Nav sheet
  - If not the same as buddy's, must come to consensus

Habitat type √ (Encompasses entire area)	
1. AGg Reef	6. Pvmnt w/Snd Chnls
2. Agg Patch Reef	7. ROck/Boulder
3. Agg Patch ReefS	8. Reef RuBble
4. PAVmnt	9. Spur And Groove
5. Pvmnt w/Ptch Reefs	10 . Snd w/Sct Coral/Rck

Island:
Local Time Zone:
Local Time = UTC +/- Hours

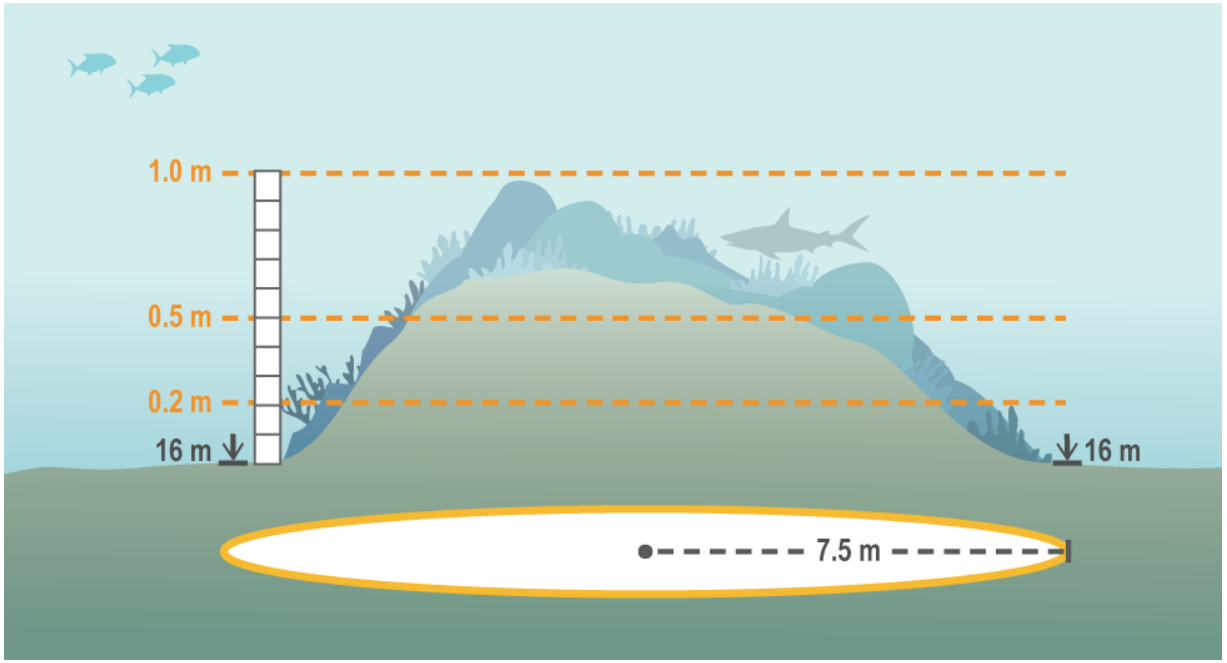
Dive and Navigation Information
Coral Reef Ecosystem Division
NOAA Pacific Islands Fisheries Science Center
Fish REA

Small Boat:
Cruise ID:
Survey Year:

Local Date	Local Time	Island 3-ltr Code / Site ID (# only)	GPS Unit #	Waypoint #	Dive #	Latitude (N/S 00.00000)	Longitude (E/W 00.00000)	Zone Type (forereef / backreef / lagoon)	Depth strata (Shallow/Mid/Deep)	Habitat type (see codes below)	Benthic Photographer (initials)	Camera #	Diver #1 (initials) PSI in/out	Diver #2 (initials) PSI in/out
2/12/15	0930	BAK 562A	4	BAK-562	1	23. 85 4017 N	- 166. 22 2567 W	FR	S	PAV	RA	8	PMA 3000/1700	KDG 2900/1500
"	1145	622A	"	BAK- 62 2	2	23. 83 5377 N	-166. 33 1938 W	FR	D	AGR	KDG	11	PMA 2900/1100	KDG 3000/900

Substrate Height

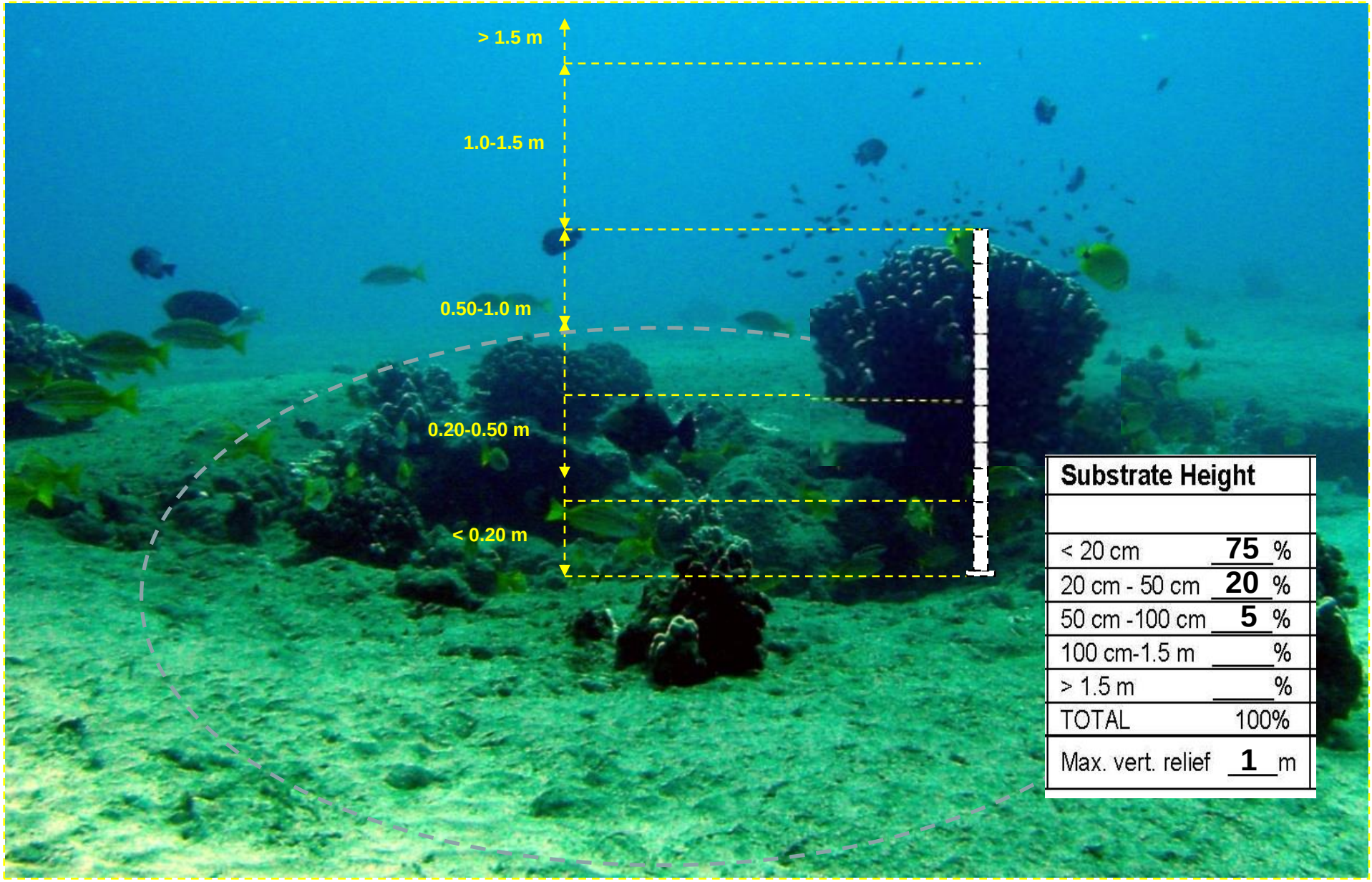
	Substrate Height		
			Free
	< 20 cm	_____%	
	20 cm - 50 cm	_____%	D (>
	50 cm -100 cm	_____%	A (5
	100 cm-1.5 m	_____%	C (2
	> 1.5 m	_____%	O (6
	TOTAL	100%	R (<
	Max. vert. relief	____m	



Estimate how much of the cylinder is comprised by each height level and note the percentages next to the appropriate categories.

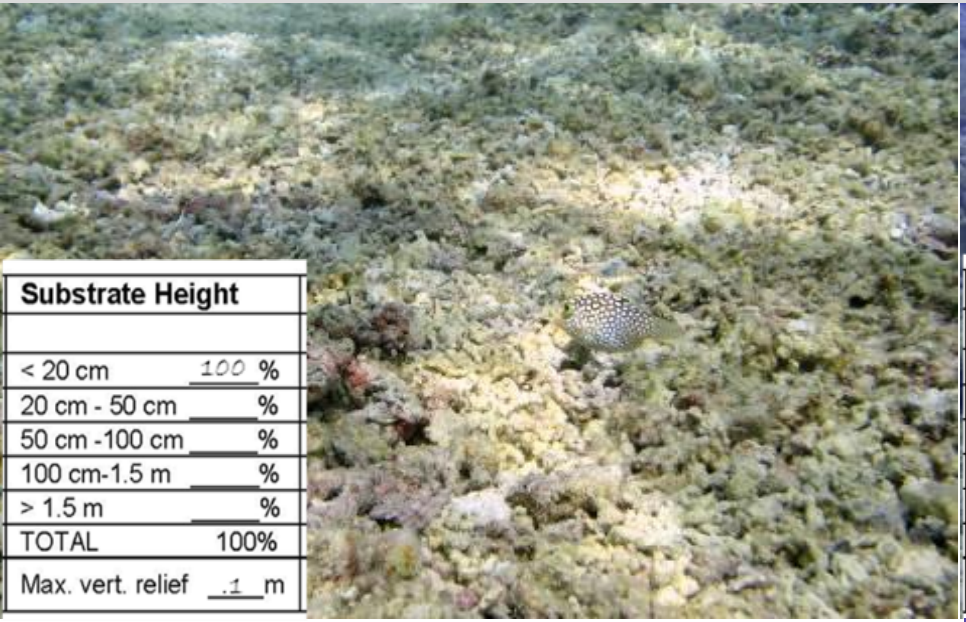
Measure maximum vertical relief as the greatest height change in your cylinder.

Substrate Height

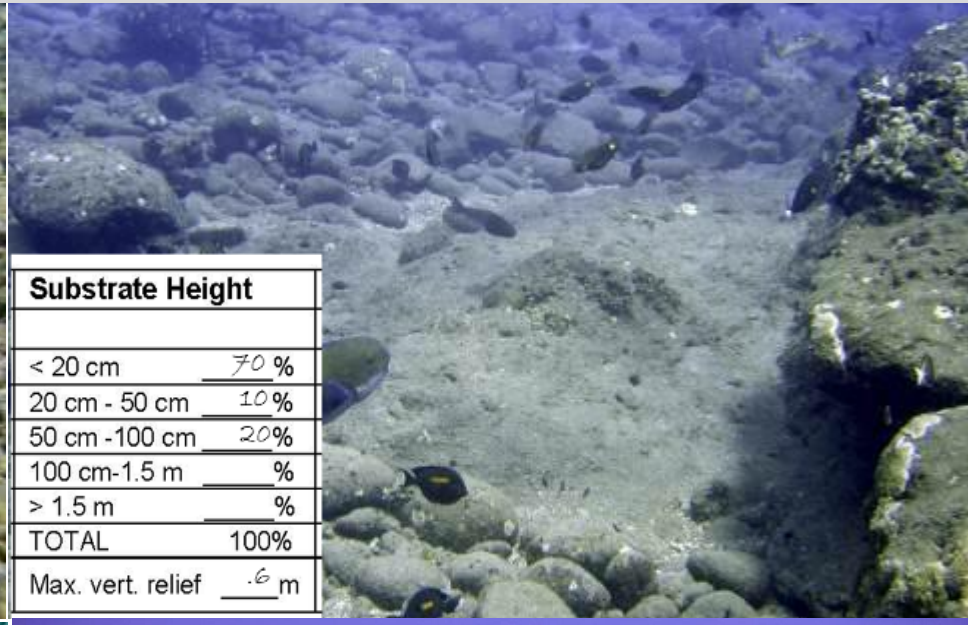


Substrate Height	
< 20 cm	75 %
20 cm - 50 cm	20 %
50 cm -100 cm	5 %
100 cm-1.5 m	%
> 1.5 m	%
TOTAL	100%
Max. vert. relief	1 m

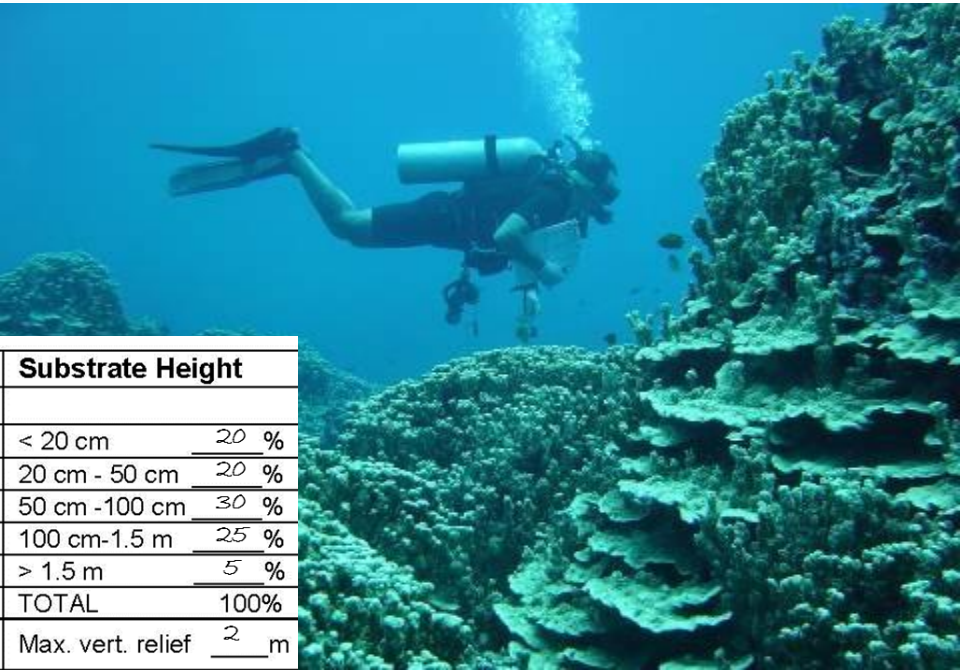
Substrate Height



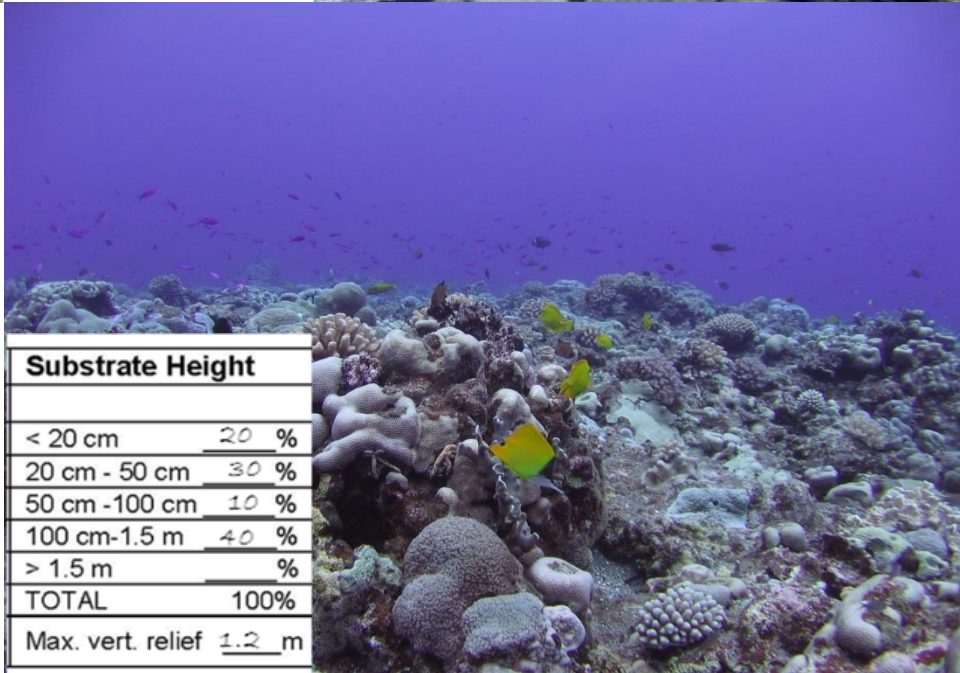
Substrate Height	
< 20 cm	100 %
20 cm - 50 cm	%
50 cm -100 cm	%
100 cm-1.5 m	%
> 1.5 m	%
TOTAL	100%
Max. vert. relief	.1 m



Substrate Height	
< 20 cm	70 %
20 cm - 50 cm	10 %
50 cm -100 cm	20 %
100 cm-1.5 m	%
> 1.5 m	%
TOTAL	100%
Max. vert. relief	.6 m

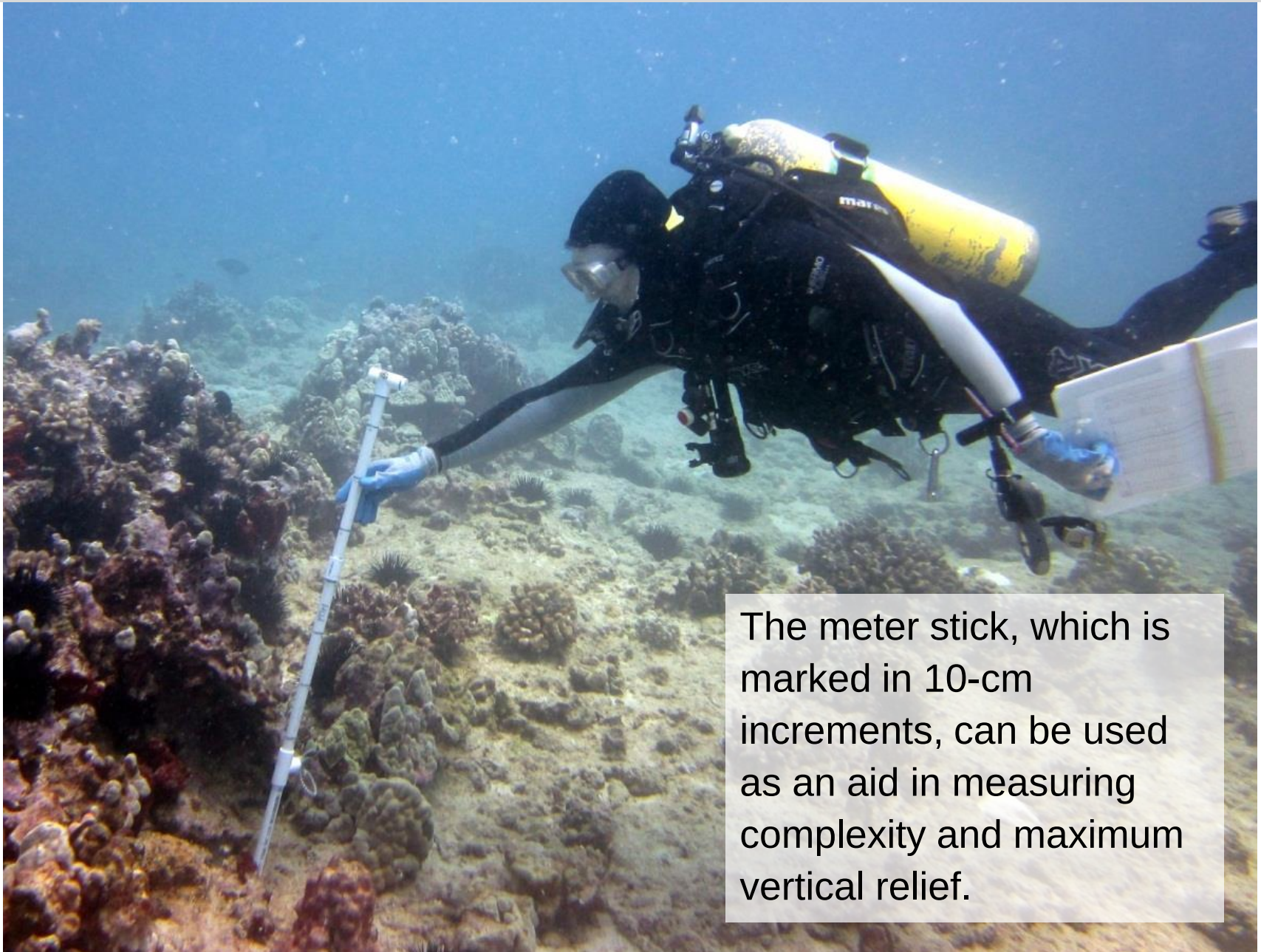


Substrate Height	
< 20 cm	20 %
20 cm - 50 cm	20 %
50 cm -100 cm	30 %
100 cm-1.5 m	25 %
> 1.5 m	5 %
TOTAL	100%
Max. vert. relief	2 m



Substrate Height	
< 20 cm	20 %
20 cm - 50 cm	30 %
50 cm -100 cm	10 %
100 cm-1.5 m	40 %
> 1.5 m	%
TOTAL	100%
Max. vert. relief	1.2 m

Substrate Height



The meter stick, which is marked in 10-cm increments, can be used as an aid in measuring complexity and maximum vertical relief.

Slope

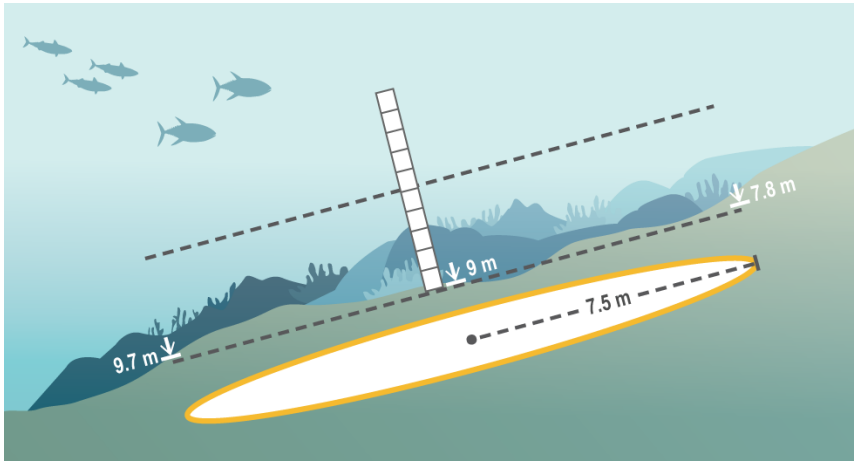
Slope is measured by taking the depth at the top and bottom of your cylinder. The values refer to the min and max depths on the imaginary plane underlying the sample cylinder.

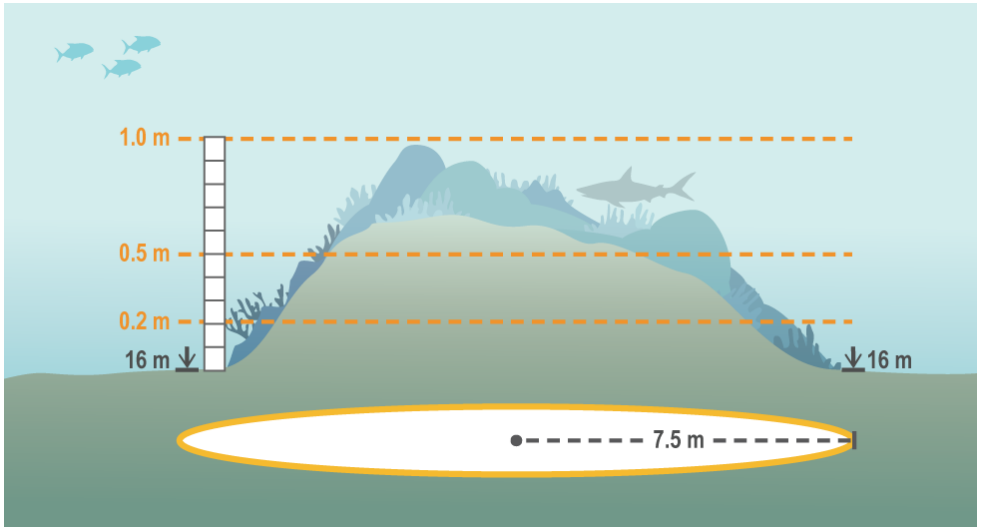
_____ Site: _____

__Visibility (m): _____ Current: None Slight Mod High

Transect Depth (m): 9 (center of your cylinder)	Substrate slope depth (m) Top: 7·8 Bottom: 9·7

Substrate Height	
< 20 cm	80 %
20 cm - 50 cm	20 %
50 cm -100 cm	%
100 cm-1.5 m	%
> 1.5 m	%
TOTAL	100%
Max. vert. relief 0·5 m	



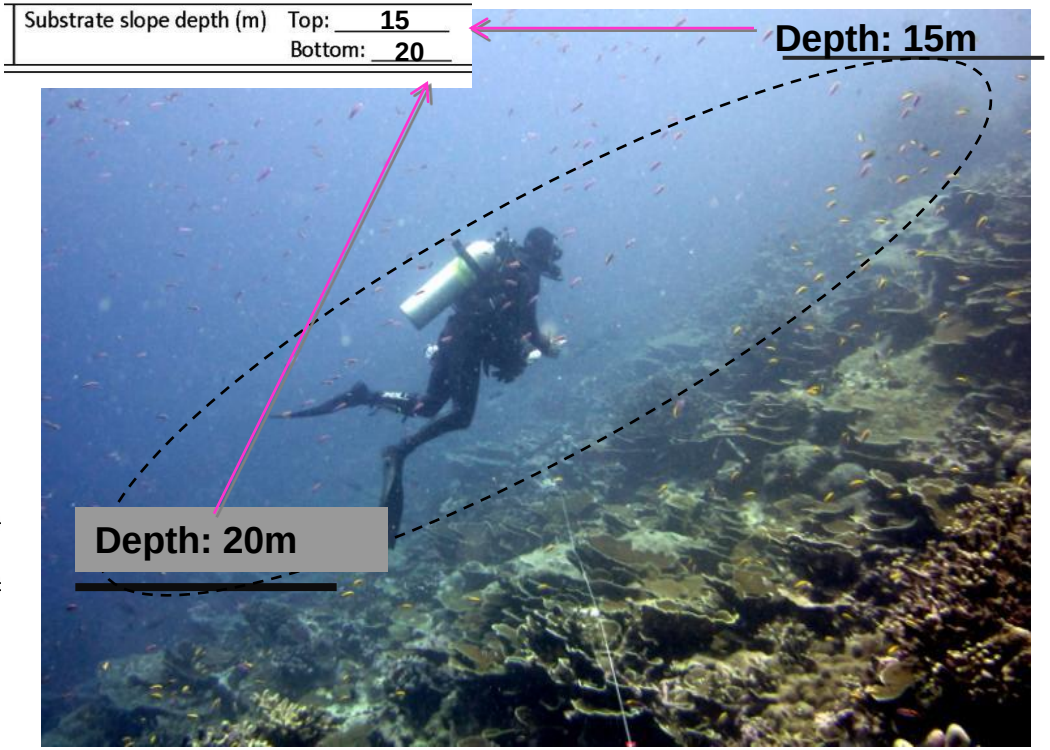


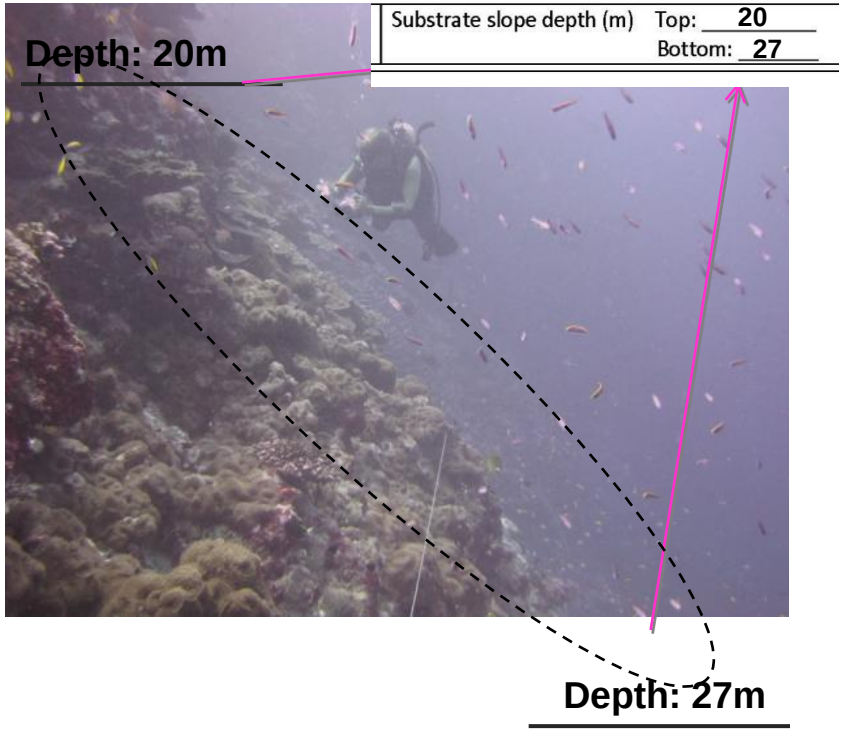
If there is no slope, the top and bottom depths will be the same.

Substrate slope depth (m) Top: 16 Bottom: 16

Slope

Examples for measuring slope:

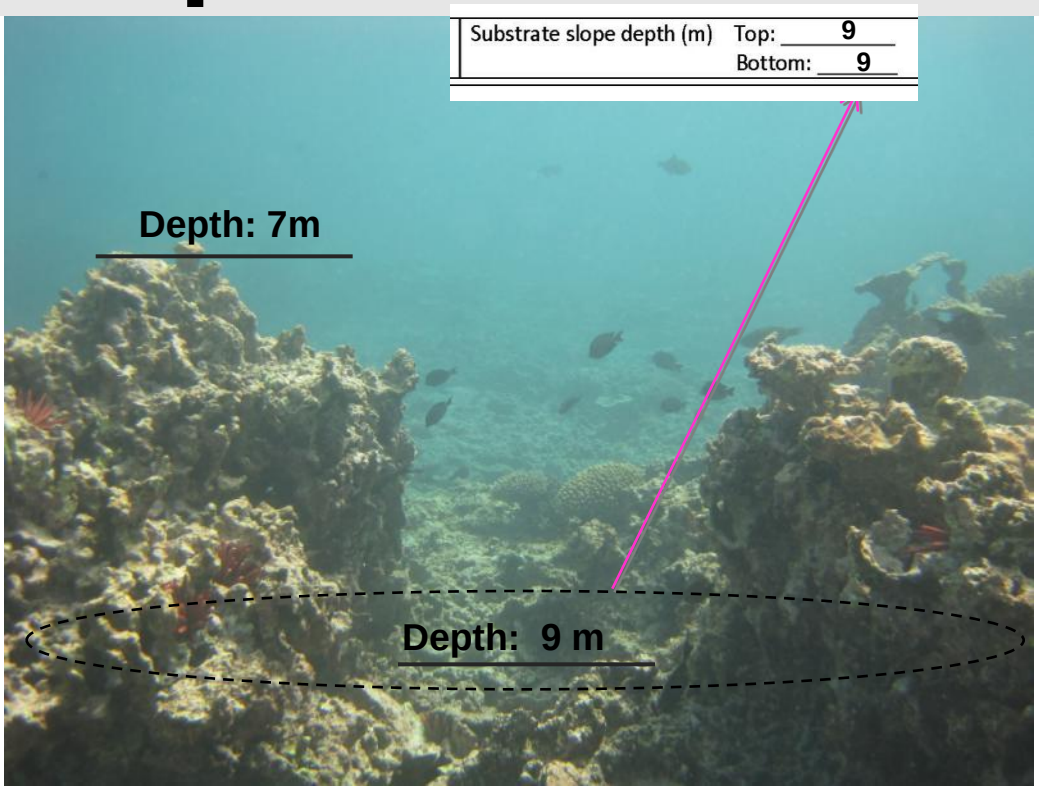


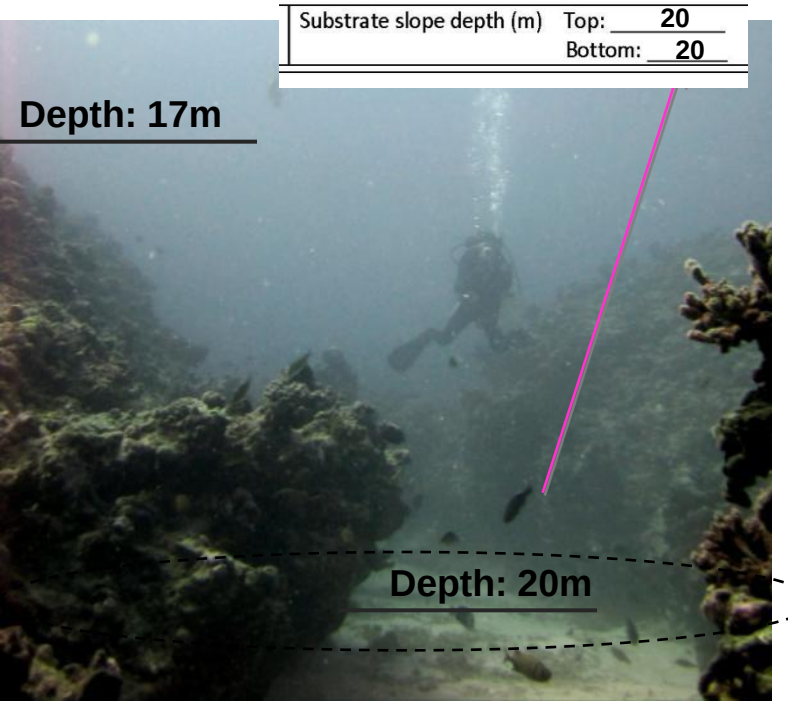


If there IS slope, then
Top depth < Bottom depth

Slope

Examples for measuring slope:





If there is NO slope, then
Top depth = Bottom depth

Urchins

DACOR (dominant, abundant, common, occasional, rare) abundance codes are used to quantify urchins in your cylinder.

As you make a sweep of your cylinder, quickly estimate the number of “free” urchins and boring urchins. You may have to do separate sweeps for each, depending on their abundances.

Because urchins are important herbivores on the reef and are mostly sessile, they are one of the few invertebrates the fish team assesses.

Urchins	
Free √	**Boring** √
D (>100)	D (>500)
A (51-100)	A (251-500)
C (21-50)	C (101-250)
O (6-20)	O (26-100)
R (<5)	R (<25)

Urchins

"Free"

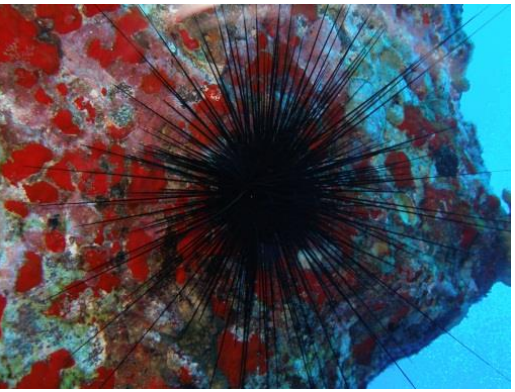
Collector urchins

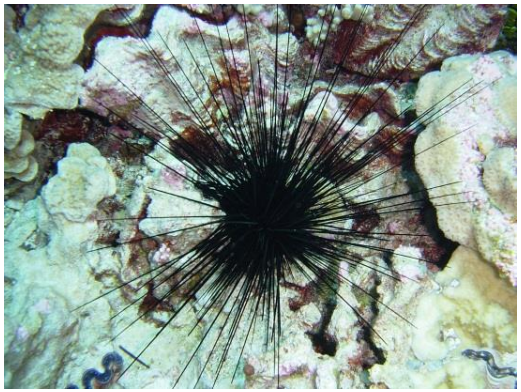
Tripneustes sp.

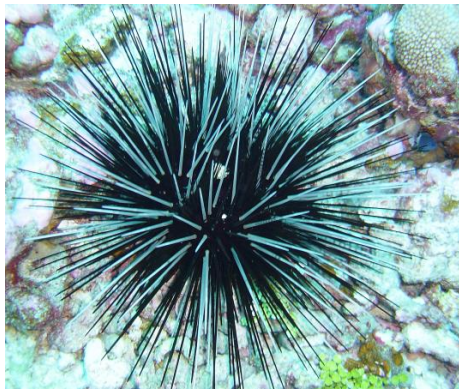
These urchins range in morphologies but are generally larger-bodied (~8-30cm) than boring urchins.

Slate pencil urchins

Long-spined urchins







Diadema sp.

Echinothrix sp.

Urchins

Boring

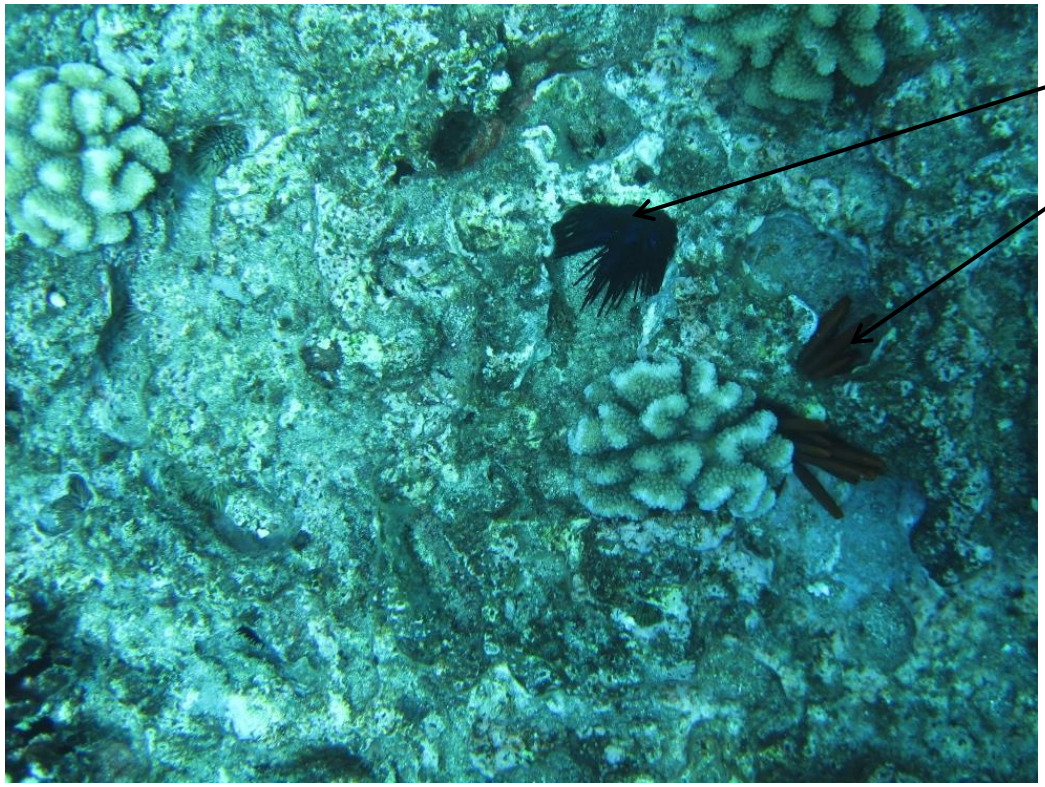
Echinostrephus sp.

Rock boring urchins, important bioeroders on the reef, can dig into solid rock and are usually smaller (~6cm), more cryptic, and more abundant than “free” urchins.

Echinometra sp.

Urchins

When counting urchins at the end of your survey, you may need to adjust your focus from looking up and around your cylinder to down into the substrate in order to not miss the smaller, less apparent boring urchins.



Urchins

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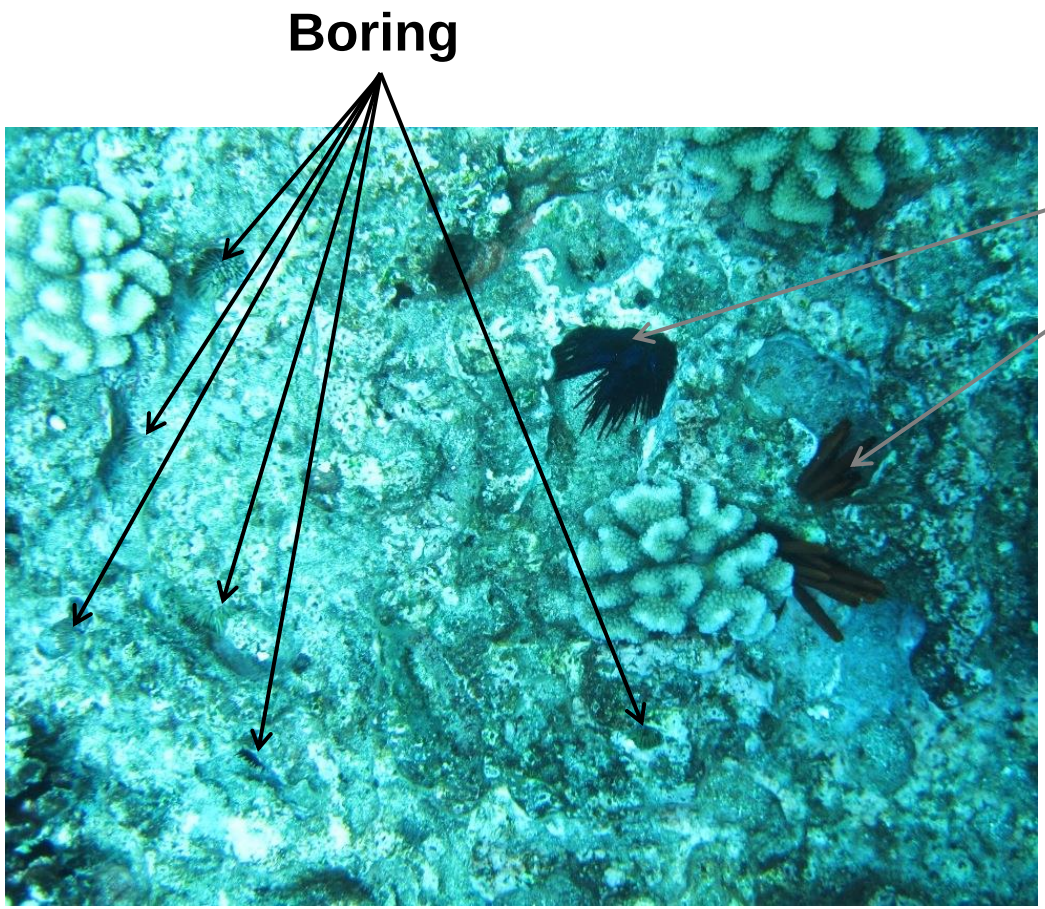
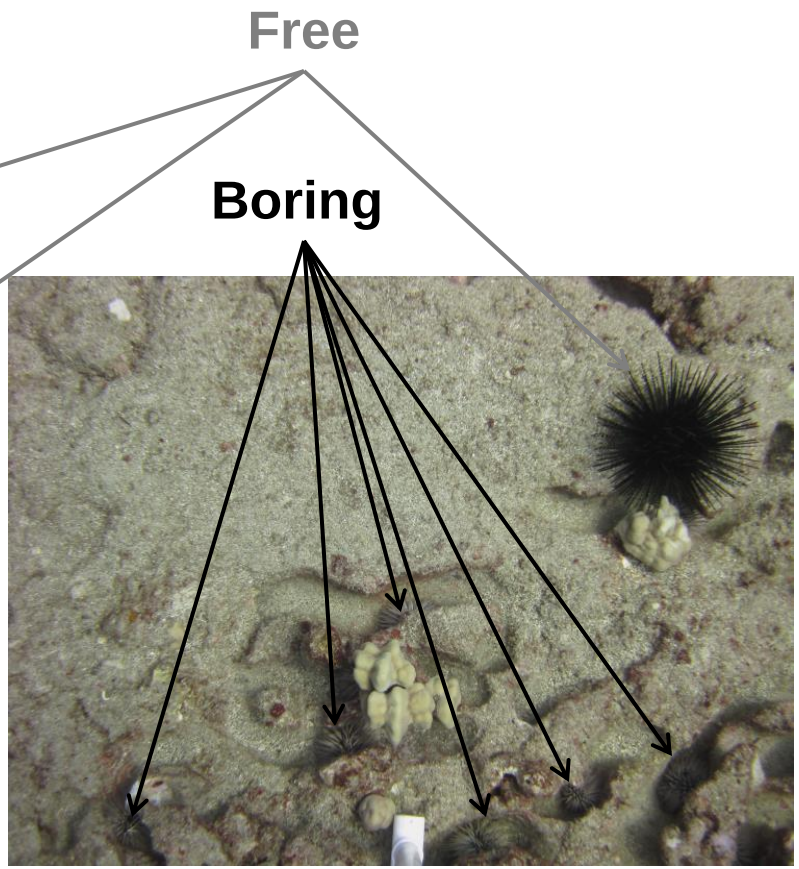
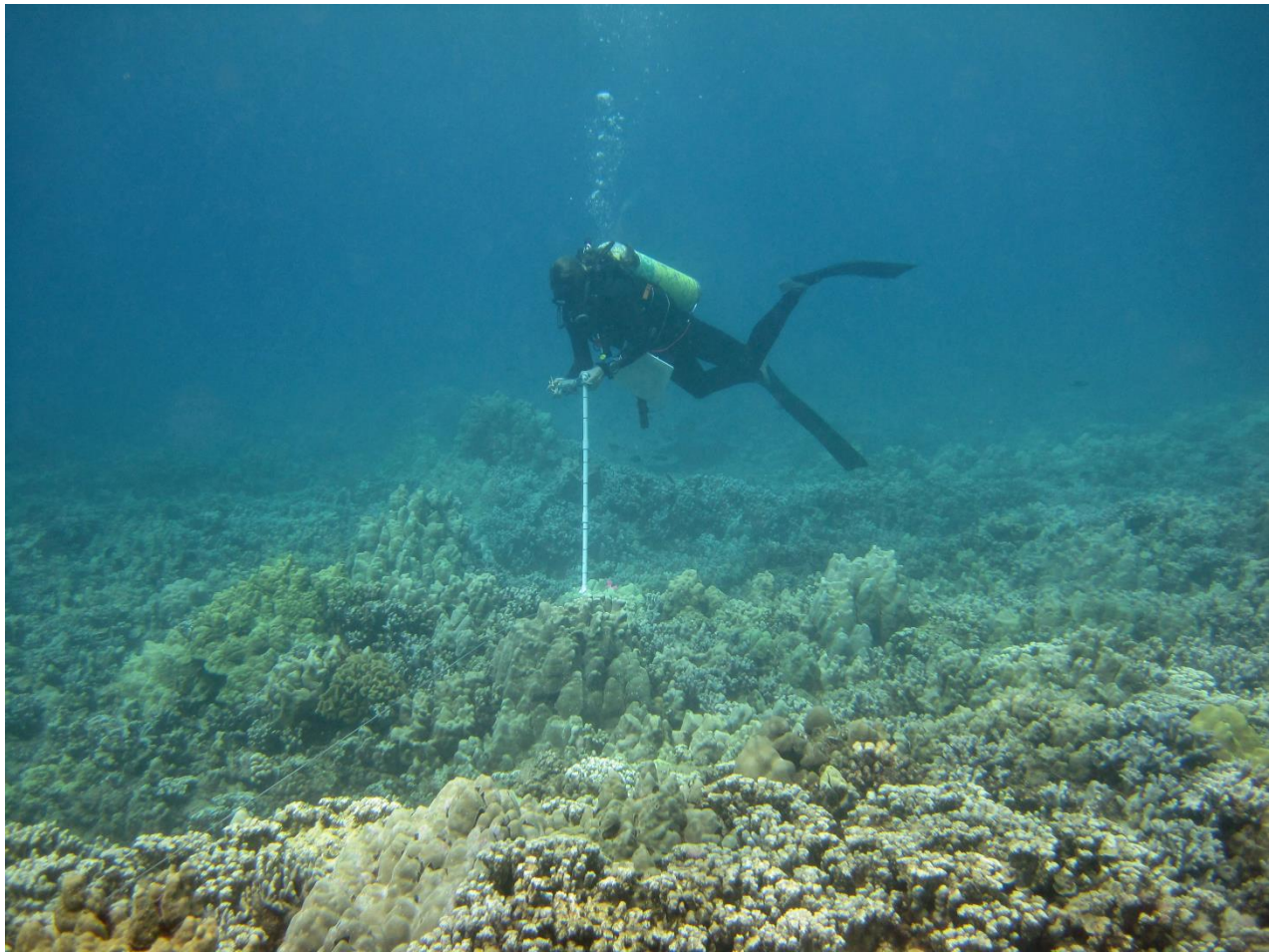




Benthic photos

You'll be taking 2 types of photos:

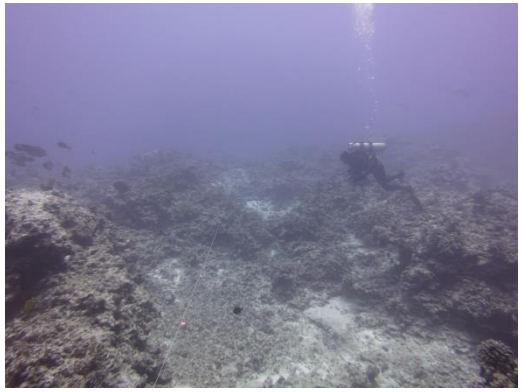
- Site
- Benthic substrate

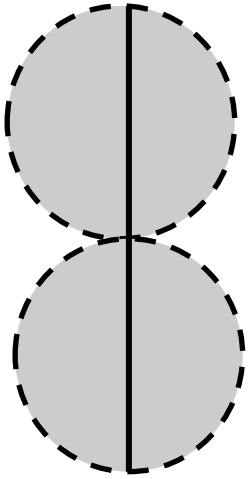


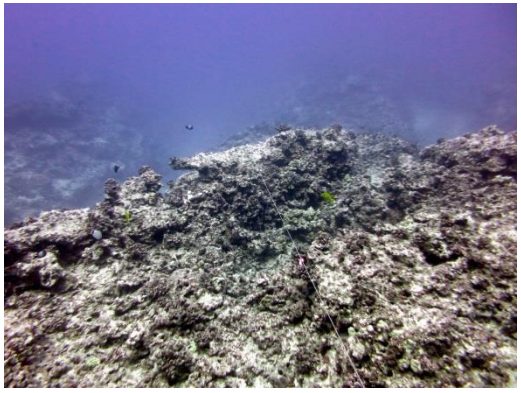
Benthic photos

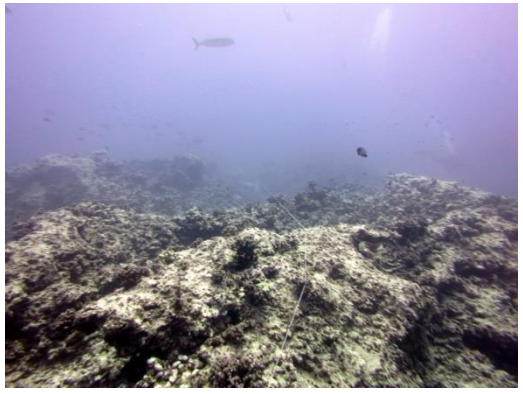
Site photos

From either the center of the transect, or the center of your cylinder, take at least 4 photos, capturing the general area.





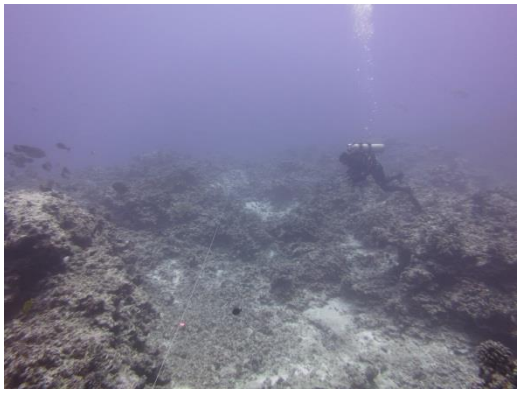




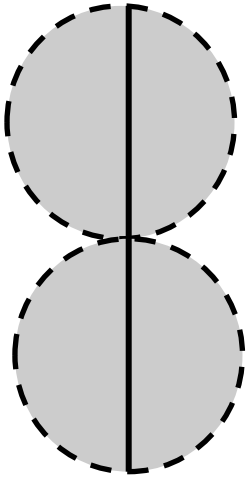
Benthic photos

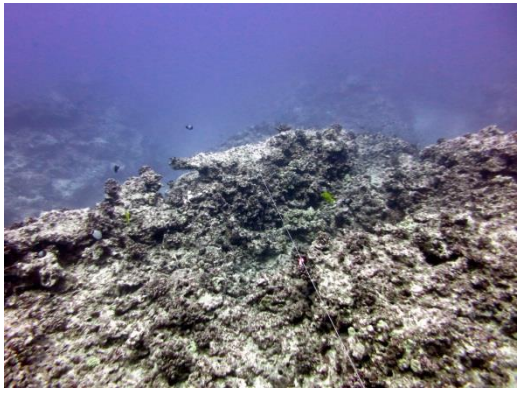
Site photos

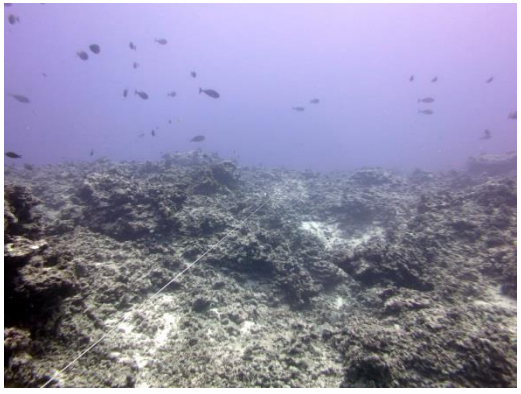
From either the center of the transect, or the center of your cylinder, take at least 4 photos, capturing the general area.

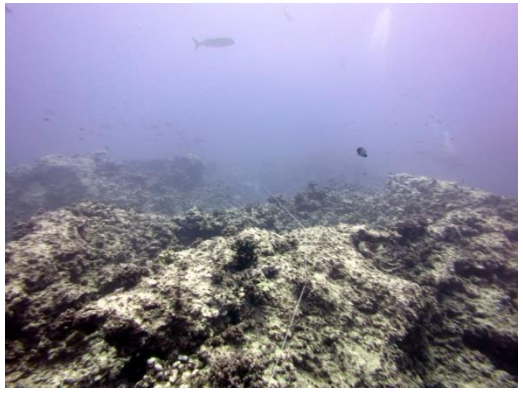


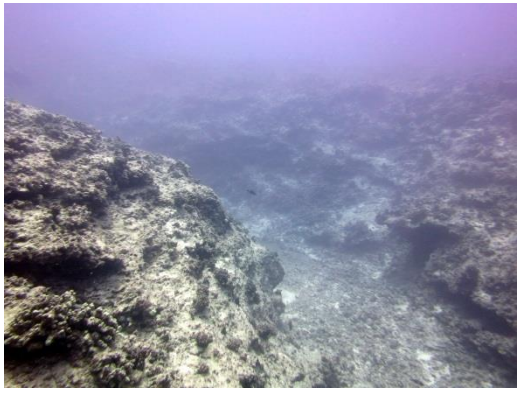
You can take a few additional photos from other locations (e.g. the very beginning of the transect), especially if the terrain is extremely variable.







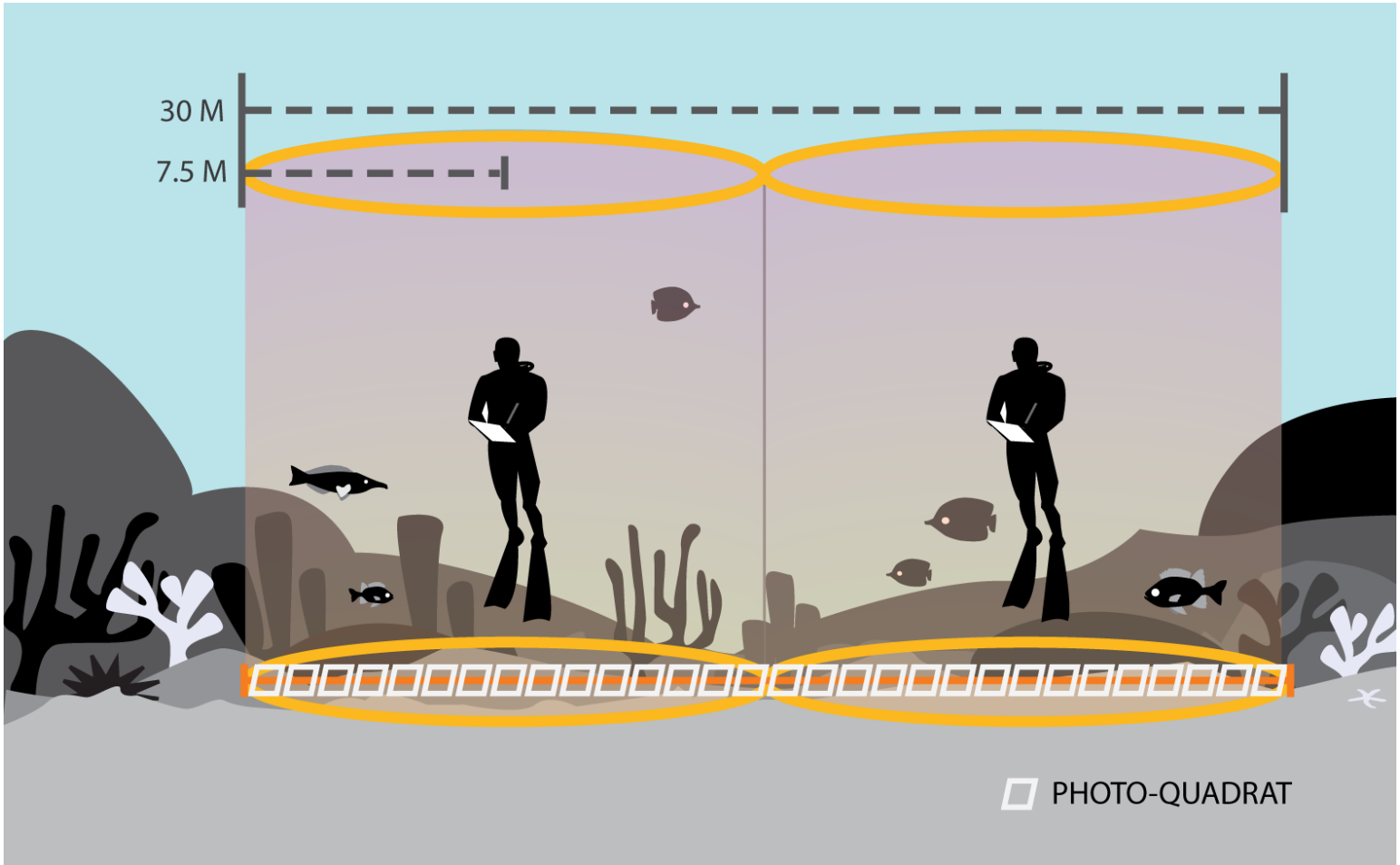




Benthic photos

Benthic substrate photos

Take a total of 30 photos at 1m intervals along the transect, starting at the end of the line, working towards the PAM float.

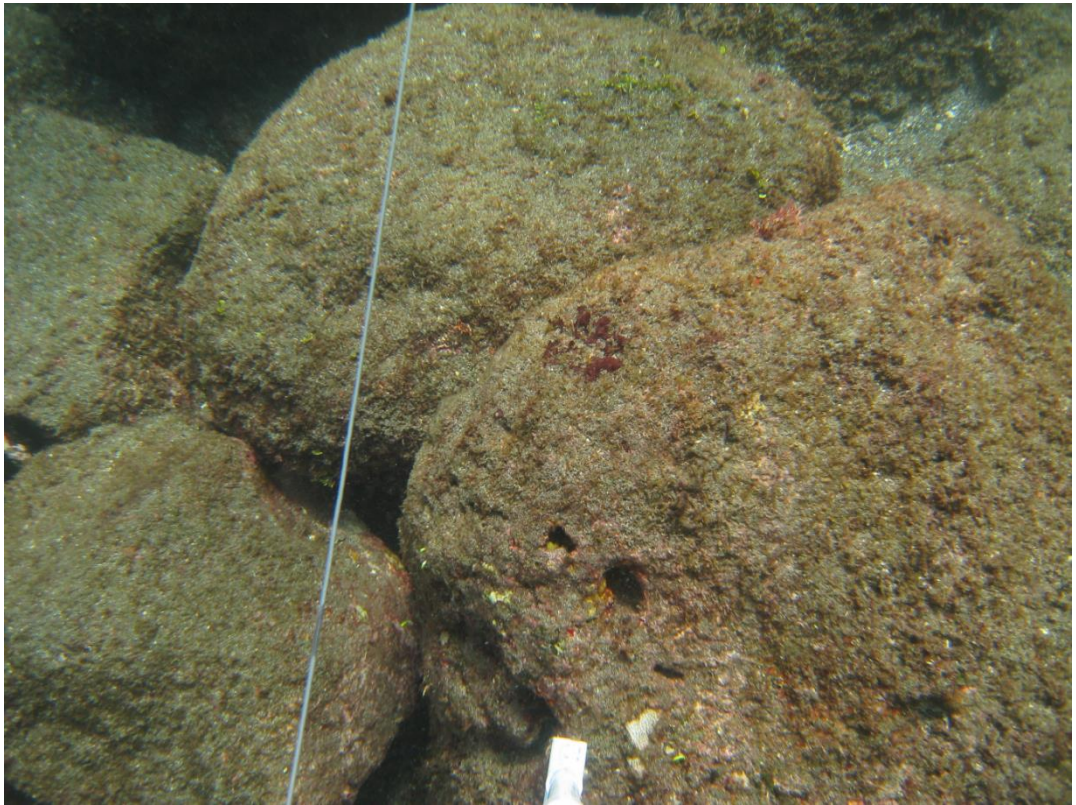


Benthic photos

Benthic substrate photos

To take photos, hold the camera at the top of the meter stick, and take each photo to the right of the transect at 1m intervals, where the line is marked.

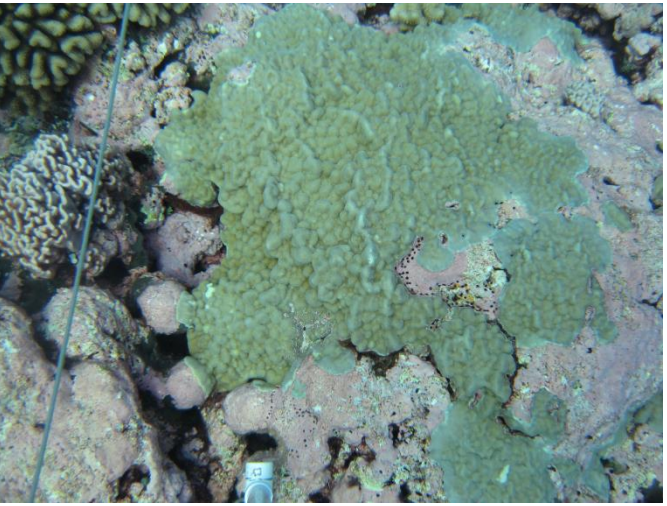
Try to get just the very end of the meter stick in the photo.



Benthic photos

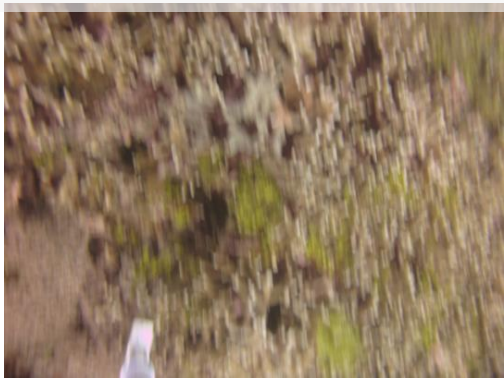
Benthic substrate photos

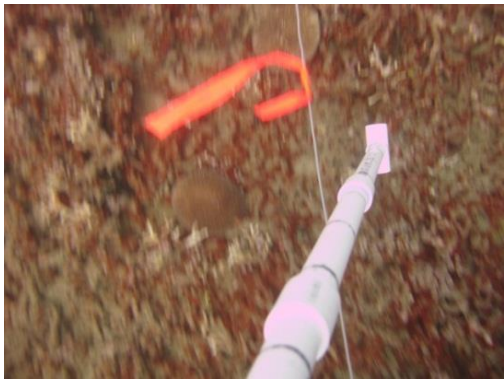
Good photos!



Check your photos as you go along. If the picture is blurry, or there are obstructions in the photo, delete it and retake it.

If you're not sure you took at least 30 photos, take a few extra at the end of the line. You can delete excess photos later.





Not so good.

Remember, benthic data is important, and…

It should take you no more than 5 minutes to gather this data. Give it your best shot, but don't spend excessive amounts of time. You'll get better with practice!

And because you only spend a few minutes during survey, you must prepare well to know what the species are, and practice estimating percent cover.

Divers will be tested on their knowledge of the benthic categories.

Some additional resources

Corals:

- National Park of American Samoa website: http://www.botany.hawaii.edu/basch/uhnpscesu/htms/NPSAcorl/plates/list.htm
- Guam corals: http://www.guamreeflife.com/htm/identification.htm
- Keoki & Yuko Stender's website (mostly corals found in Hawai'i): http://www.marinelifephotography.com/corals/corals.htm

Corals, algae (and fish!):

- University of Hawaii Marine Option Program QUEST study materials (Hawaii species): http://www.uhhmop.hawaii.edu/quest/species.shtml